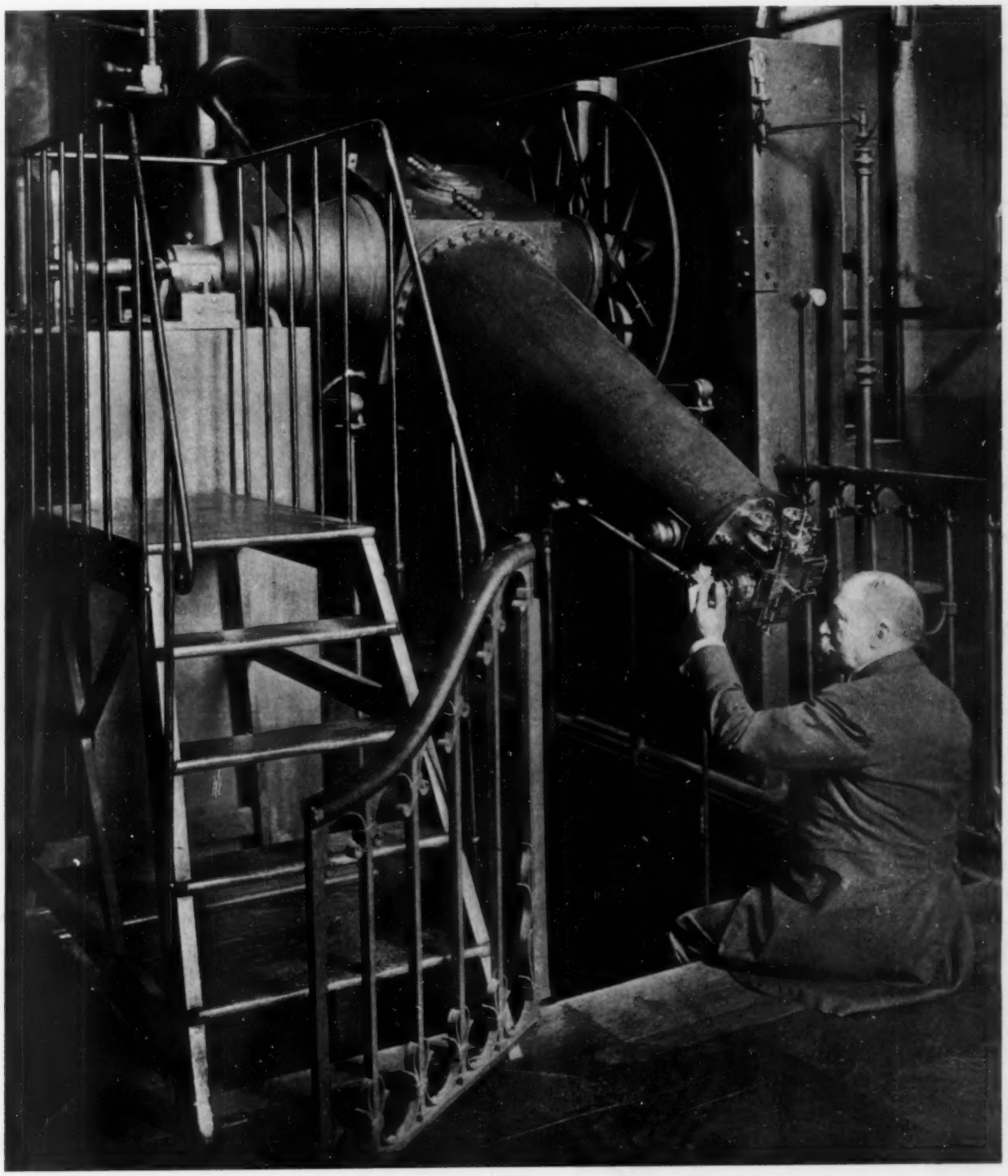
MAR 13 1915

SCIENTIFIC AMERICAN



THE LARGE TRANSIT CIRCLE AT THE PARIS OBSERVATORY, NOW USED ONLY FOR OBTAINING ACCURATE TIME.—[See page 251.]

Vol. CXII. No. 11
March 13, 1915

Munn & Co., Inc., Publishers
New York, N. Y.

Price 10 Cents
$3.00 A Year

Reg. U. S. Pat. Off.

"Barreled Sunlight" has been used by over 3000 firms, because it greatly increases daylight in the plant, and also improves sanitary conditions

MANUFACTURERS with an eye to increased profits should investigate Rice's Mill-White. The Electrical Testing Laboratories, New York, testified after exhaustive experiments that it increased daylight 19% to 36%. This allows employees to turn out more and better work each working day, because they can *see* better.

Rice's provides a handsome tile-like, glossy surface to ceilings and walls—firm, yet elastic enough to resist the vibration of heavy machinery; it does not crack nor scale. Sanitary conditions in the plant are improved, because it does not collect dust and germs, and can be washed with soap and water, without affecting the gloss.

RICE'S GLOSS MILL-WHITE

has another striking advantage. It is ultimately the most economical interior finish for a plant. It saves money by making repainting less frequent. *It can be applied over cold-water paint.*

Many of the most representative concerns in the country use "Barreled Sunlight"—firms like Eastman Kodak Co., Hyatt Roller Bearing Co., etc. Its success has been so marked that many imitations have sprung up, but these are all *varnish* paints. Rice's, on the contrary, is an OIL paint. It is made by a process over which we have exclusive control, which causes it to remain white longer than any other and preserves it from either cracking or peeling. The tremendous advantages of this process enable us to make the following guarantee:

WE GUARANTEE that if Rice's does not remain white longer than any other gloss paint, applied at the same time and under the same conditions, *we will give, free, enough Rice's to repaint the job with one coat.* We also guarantee that, properly applied, Rice's will not flake nor scale. You cannot lose under this guarantee.

Rice's Granolith

A tough and elastic permanent finish for concrete walls. Becomes a part of the cement to which it is applied. One coat sufficient, unless a gloss is desired. Makes the best possible primer on inside concrete and brick for a second coat of Rice's Mill-White Paint, giving a tile-like enamel finish at no more expense than lead and oil paint.

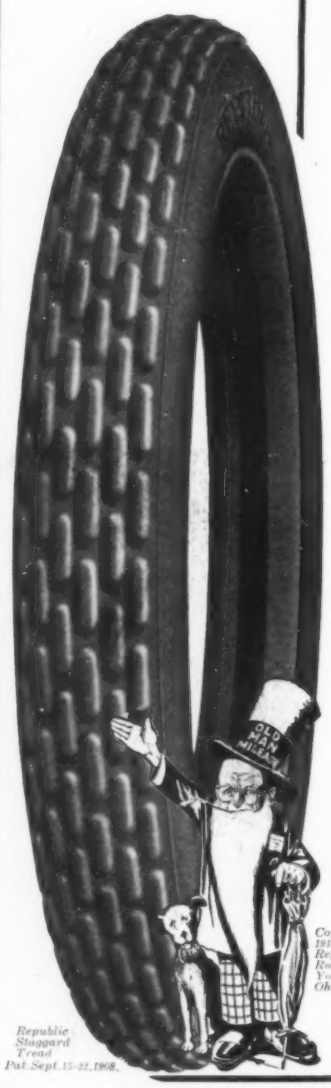
For Concrete Surfaces

Sold direct—write us for booklet and sample board

Sold direct from our factory in barrels containing sufficient paint to cover 20,000 square feet—one coat.

U. S. GUTTA PERCHA PAINT CO.

23 Dudley Street Providence, R. I.



Republic Staggard Tread Pat. Sept. 15-22, 1908.

Copyright 1914 by The Republic Rubber Co. Youngstown, Ohio

Old Man Mileage Says:

"Tire *Economy* Comes Only from Tire *Quality*"

"And tire quality can only be had in a tire that is built to give mileage, not to meet a price."

"Republic Tires are Quality Tires. They cost more to buy and less to use than any tire made. They yield the maximum of uninterrupted road service at the minimum cost per mile."

"Republic Casings are made in Staggard, Plain and WM Treads. Of these, the Staggard Tread is the leader. It is the original non-skid tire bearing patent dates. Its long, tough studs give you the greatest freedom from skidding and the most efficient traction. Its wonderful construction yields the finest riding qualities at the lowest mileage cost."

"Republic Black-Line, Red Inner Tubes, and Republic Grey Inner Tubes are the finest that skilled workmanship and highest quality material can produce."

Write for interesting book

Old Man Mileage has written a book on tire values that is of vital interest to every tire buyer. Write for it—read it—then buy a "find out" Republic. It will mean a big saving to you.

The Republic Rubber Co., Youngstown, O.

Branches and Agencies in the Principal Cities

REPUBLIC TIRES

PLAIN, "WM" AND STAGGARD TREADS

TRADE MARK REGISTERED U. S. PATENT OFFICE

REPRINTING

OF THE

Scientific American Supplement

TO BE DISCONTINUED

The Scientific American Supplement is a unique periodical.

Established in 1876 to describe the exhibits of the Philadelphia International Exposition, it proved so successful that the publishers decided to continue on broader lines.

Whenever a Tyndall, a Huxley, a Helmholtz, a Pasteur, a Liebig, a Crookes or any other prince of science rose in the learned societies of Europe and announced some new epoch-making discovery of his, his own words appeared in the Scientific American Supplement. The technical papers read by engineers before societies in America—papers too recondite and too long for more popular periodicals—have been given a place in the Scientific American Supplement. Americans who could not read foreign languages found in the pages of the Scientific American Supplement, the utterances of great European physicists and chemists translated into English.

So, in the course of time, the Scientific American Supplement has become a kind of encyclopedia of original scientific sources. It figures over and over again in the footnotes to monographs and scientific treatises; it has played its part in research of all kinds.

As remarkable as the publication itself is the method by which it has been made accessible to the general public. **Every number of the Scientific American Supplement from 1876 to 1915 has been kept in print. What is more, the numbers of 1876 have been sold for 10 cents just as if they were published today.** And this despite the fact that publishers of newspapers and periodicals often charge several hundred per cent more for back numbers than for new ones.

The Scientific American Supplement will continue to print the papers of great scientists and engineers as it has in the past. **But the policy of reprinting back numbers will be discontinued.**

For a few weeks only we shall be able to furnish all the single numbers of the Scientific American Supplement or bound volumes.

This announcement is made for the benefit of libraries in which complete sets of the Scientific American Supplement are not to be found, and for those interested in science who feel a genuine need for an encyclopedia of science of the most diversified kind.

We will also supply, free of charge, on request with any order, copies of the Scientific American Supplement Catalogue, in which all the papers that have been printed in the Supplement since 1876 are indexed. This catalogue will not be published in the future.

Order back numbers or bound volumes of the Scientific American Supplement now either from your bookseller or directly from the publishers.

MUNN & CO., Inc., *Publishers*, 233 Broadway, New York

SEVENTY-FIRST YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXII.
NUMBER 11.

NEW YORK, MARCH 13, 1915

10 CENTS A COPY
$3.00 A YEAR

Panama Canal Open to Large Ocean Liners

THAT the recent heavy slides in the Culebra cut have not by any means stopped the traffic of ocean-going ships is proved by the accompanying illustration, which shows the "Kroonland," of 22,000 tons displacement, the largest ship which has navigated the canal, passing through Culebra cut at a point opposite the troublesome Cucaracha slide.

It will be remembered that the last movement of this slide was so serious that the material practically cut off all navigation. That the channel has been opened sufficiently for such a large ship as the "Kroonland," which is nearly 600 feet in length, to pass through, is due to the very powerful dredging machinery which was ordered by Col. Goethals about two years ago for this very kind of work. The two huge dipper dredges of the Gamboa type, aided by ladder dredges and hydraulic dredges, have made such rapid inroads on the slide that when the "Kroonland" passed through, the canal presented to the eye a normal condition. That there will be other slides is probable; but they will decrease in size and number as the days pass by, and the time is probably not far distant when the banks of the great Culebra cut, which is nine miles in length, will on both sides have found a slope of permanent repose.

According to the last statement from the Navy Department, the fleet will not be sent through the canal, but will probably content itself with entering Gatun Lake and taking part in a review in those waters. We think that this is a wise course; for if the ships did pass through to the Pacific side, and a slide of magnitude occurred, they might find themselves under the necessity of passing around Cape Horn in order to make sure passage back to Atlantic waters. In view of the present disturbed condition in Europe, and the many diplomatic questions of international scope which are arising day by day, this condition of affairs would certainly be deplorable.

The First National Bird Census

THE much-talked-of "census of the birds" taken last summer by the U. S. Biological Survey undoubtedly led to popular misconceptions as to the purpose and scope of this novel undertaking; hence, there was ample need for Bulletin 187 of the Department of Agriculture, just issued, entitled "Preliminary Census of Birds of the United States," in which the subject is put in its proper light.

The first extensive undertaking of similar character in this country, but on a local, not a national, scale, was the "sectional bird census" taken at Berwyn, Pa., during the seasons of 1899, 1900, and 1901, by F. L. Burns. In that case 588 pairs of native birds were found breeding on 640 acres. In the summer of 1907 the University of Illinois conducted a series of statistical bird studies in southern Illinois. A bird census of a tract of land near Washington, D. C., has been taken annually for some years by the Biological Survey.

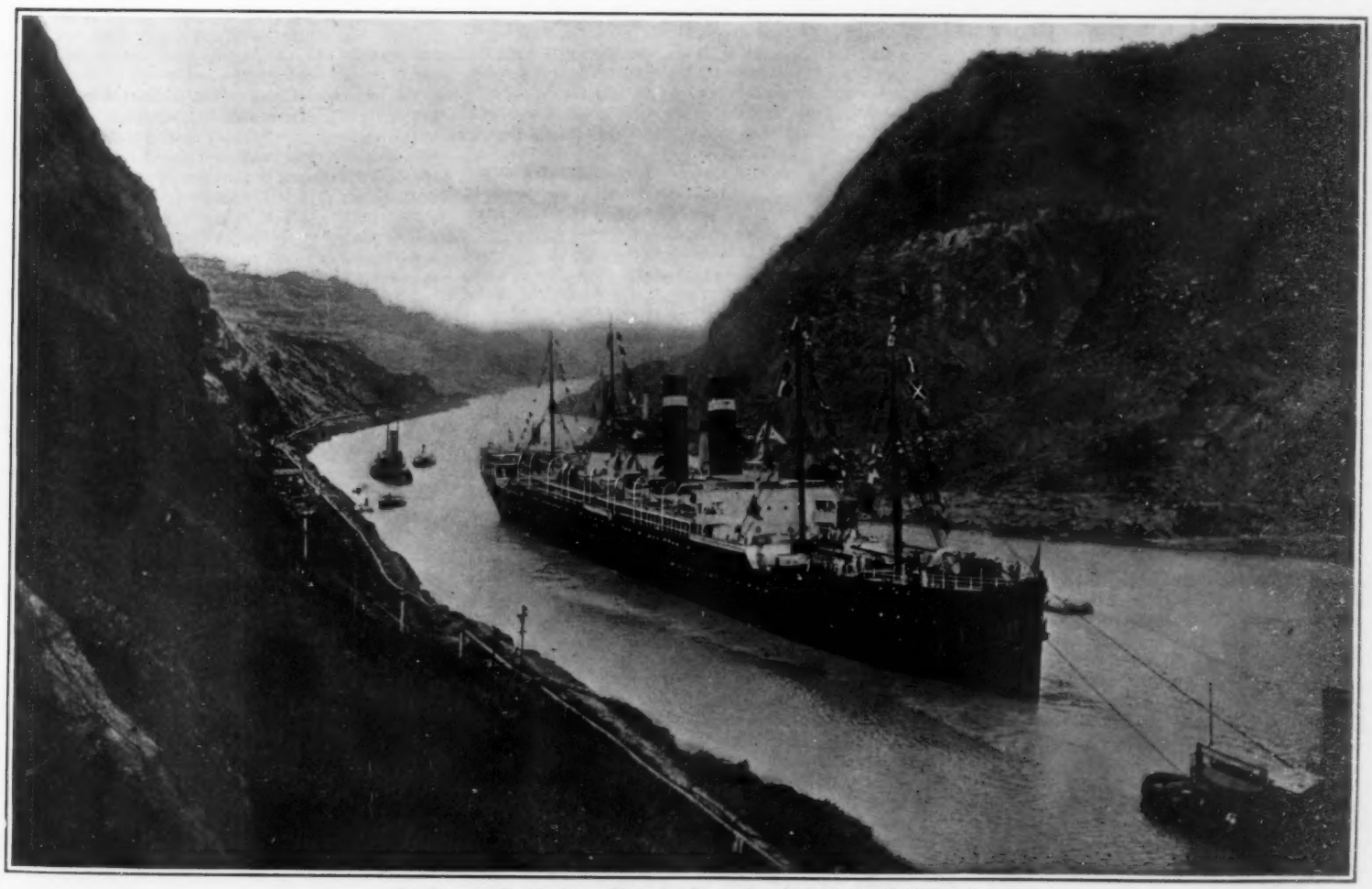
As Congress has recently placed the Department of Agriculture in charge of migratory game and insectivorous birds, in connection with protective legislation, it has become necessary to ascertain the abundance and distribution of the various species throughout the country as far as possible from year to year, so that the effectiveness of protective measures can be tested. The census of 1914 was, therefore, but the first of a series. It was really of a very fragmentary character, embracing the reports of less than two hundred volunteer observers. Each of these selected a tract of farmland ranging from forty to eighty acres and conforming approximately to certain specifications; on this tract a daily early morning reconnaissance was made for several days at the height of the breeding season, and the number of male birds (at that season in full song) was counted; also the number of each species. Each male was assumed to represent a breeding pair.

In this first census only the northeastern States were covered with some degree of completeness, though there were a few scattered observers in the West and Southeast. The results were, however, decidedly interesting and significant. The densest bird population was found at Chevy Chase, Md. (a suburb of Washington), where 161 pairs of thirty-four species were found nesting on twenty-three acres. Here it was noticeable that the blocks most thickly inhabited by people were also most fully occupied by breeding birds. The census showed that the commonest bird in the northeastern United States is the robin, with the English sparrow a close second; while the catbird, brown thrasher, house wren, kingbird, and bluebird follow in the order named. The English sparrow, ordinarily thought of as a city bird, is common on farms, averaging about five pairs to the farm in the northeastern States. A few years ago a severe winter destroyed nearly the whole bluebird population of the eastern States, but the census indicates that there are now several million of this popular species in the northeastern part of the country.

A much more thorough census will probably be taken this year.

Power Developed in Cannons

MONSIEUR LE COMMANDANT REGNAULT has calculated the actual horse-power developed during the firing of a projectile by some modern specimens of artillery. The results are truly astounding. In the case of a cannon of moderate size, projecting a projectile weighing 7 kilogrammes with an initial velocity of 500 meters, the deflagration of the explosive lasting about one hundredth of a second, we have, during that time, work done to the extent of 115,000 horse-power. For larger artillery, where the weight of the projectile reaches and surpasses 500 kilogrammes, the initial velocity being 900 meters, we have no less than 25 million horse-power developed during the explosion. These figures give an idea of the formidable efforts which the metal of modern pieces of artillery has to support.



The Panama-Pacific liner "Kroonland" passing through the Culebra cut.

This fine American-built ship and her sister the "Finland" are about to enter the regular passenger trade between New York and San Francisco *via* the Panama Canal. Each ship is 580 feet long and of 22,000 tons displacement. The "Kroonland" is here seen passing the Cucaracha slide, near the point of deepest excavation.

SCIENTIFIC AMERICAN

Founded 1845

NEW YORK, SATURDAY, MARCH 13, 1915

Published by Munn & Co., Incorporated. Charles Allen Munn, President; Frederick Converse Beach, Secretary
Orson D. Munn, Treasurer
all at 361 Broadway, New York

Entered at the Post Office of New York, N. Y., as Second Class Matter
Entered as Second Class Matter at the Post Office Department, Canada.

Trade Mark Registered in the United States Patent Office
Copyright 1915 by Munn & Co., Inc.
Illustrated articles must not be reproduced without special permission.

Subscription Rates

Subscription one year ..... Postage prepaid in United States and possessions, Mexico, Cuba, and Panama	$3.00
Subscriptions for Foreign Countries, one year, postage prepaid.	4.50
Subscriptions for Canada, one year, postage prepaid	3.75

The Scientific American Publications

Scientific American (established 1845) ..... per year.	$3.00
Scientific American Supplement established 1876. " "	5.00
American Homes and Gardens ..... " "	3.00

The combined subscription rates and rates to foreign countries including Canada, will be furnished upon application.
Remit by postal or express money order, bank draft or check

Munn & Co., Inc., 361 Broadway, New York

The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp* the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

For the Defense of the Country

IF ever there was a case of a "tempest in a teapot" it is to be found in the excitement which has been stirred up in Washington over that patriotic movement which is known as the American Legion. The object of the Legion is merely to obtain the names and addresses of those citizens who, in the event of an attack on this country, would be prepared to volunteer for its defense—just that and nothing more.

Whenever war has come quickly upon the country, as in the case of the Spanish war, and the President has sent out a call for volunteers, there has been a great deal of confusion and delay in getting the volunteers together, weeding out the fit from the unfit, and placing the men in their respective training camps. The object of the American Legion is merely to provide and file at certain headquarters lists of competent men, who in an emergency would instantly respond to a call to arms and volunteer for the service of their country.

Surely it is the right of an American citizen to inform the Government that if it should need his services he stands ready on the receipt of letter or telegram to present himself at the place for volunteer enrollment. Surely, the recognition of this right, and the endeavor to have an organized system of properly filed and docketed addresses of these citizens is neither an encroachment on the domain of the army, nor the usurpation of any Government function.

As a matter of fact, this movement is distinctly in line with the policy recently enunciated by our President, when he advocated the preparation of a trained force of citizen soldiery. And if the authors of this movement have asked and received the advice of officers of our Army, given in their capacity as private citizens, we fail to see that there has been the least impropriety of conduct, either on the part of the citizens themselves or of the officers who have been approached.

As a matter of fact, the whole fuss is foolish and puerile, and so far from the movement being discouraged by Government officials, whether of the executive, the legislature, or the army, it should receive from these gentlemen every possible help and encouragement.

The fact is that in the matter of the pressing urgency of national defense, Congress and the whole present administration, with the notable exception of the Secretary of War, is wofully out of touch with the nation at large. We speak advisedly, for the series of articles which we have recently published under the caption "The United States—An Undefended Treasure Land," has brought to this office an unusually large number of letters, strongly commending the stand which we have taken; whereas we have not received a single letter in opposition to the plans for defense as outlined in those articles.

It is our belief, indeed, that the most important, by far the most important, matter which will come before Congress at its next session will be that of providing adequate naval and military defenses for the United States; and if our Congressmen will but take the trouble to get in close touch with their constituents and lay their hands upon the public pulse, they will find that the time is ripe for them to make good the deficiencies of the past, deficiencies which are due more than anything else to the fact that Congress has been playing politics with this question, when it should have given the matter its earliest and most serious attention.

Two years ago in Berlin the writer had a lengthy conversation with a general who is now commanding one of the German armies in the western theater of the present war. Immediately upon introduction, he said: "It is amazing to me that a country as large and wealthy as your own and proclaiming a line of policies of such importance as the Monroe Doctrine, the Open Door in China and the exclusion of the Asiatics, fails to see the necessity for providing adequate naval and military forces to take care of its interests. I well understand," he said, "that yours is not in any sense a militaristic nation; but it seems to me that if you fail to provide an army proportionate to your size and wealth and international policies, you are liable some day in the future to be subjected to a great national calamity."

The defenselessness of the United States is perfectly well understood by the foreign powers, and to every one of them the failure of Congress to provide a reasonable army of defense is looked upon as an invitation to a disaster of the first magnitude.

Forcing the Dardanelles

A GREAT many unexpected things have happened during the present war, and chief among them is the success with which the allied British and French fleets are forcing the passage of the Dardanelles. This strait, some forty miles in length, fairly bristles with powerful, long-range guns, and its waters are known to be extensively sown with mines. Theoretically it should mean destruction to any ship or fleet which attempts to enter these waters and by the removal of the mines, and the reduction of the forts, break its way through to Constantinople.

Before the opening of the war and, indeed, up to the time of this bold attempt on the part of the allied fleets, it was held that the accuracy of shooting possible by the guns of coast fortifications, and their extreme ranging power, was such as to render it impossible for any warship to come within range without imminent danger of being sent to the bottom. When it comes to a matter of fighting at distances of from ten to fifteen thousand yards, the effectiveness of gun-fire depends, primarily, upon the ability of the contestants to estimate the range of the ship or the fort as the case may be. The distance is estimated by the well-known system of triangulation, in which the length of the base line is known and also the two base angles. The accuracy of the distance, as thus calculated, will naturally increase with the increase of the base line upon which the calculations are determined. On the ship, the triangulation is done automatically by a range-finder in which the base line is from, say, nine to twenty-one feet in length; and everyone will recognize that a calculation of a distance of twelve to fifteen thousand yards on a base line of seven yards requires great accuracy, both in the instrument and its adjustment by the observer. When the shots begin to land on the fort, observers on the ship attempt to "spot" the fall of the shot by the dust which is raised, or by the smoke of the explosion—a very difficult matter, particularly when the fortification is elevated above sea level.

Calculation of the distance of the ship by observers in the fort is more accurate because a base line of great length, even up to a mile, may be used, and the angles at the ends of this base line to the ship can be most accurately determined. Furthermore, it is possible to observe the splash of the shots, and determine how much they are over or short of the ship with great precision, particularly if the fortification is elevated considerably above sea level. Furthermore, the fortification guns are on a solid platform and the gun-sight may be held absolutely upon the mark. There is no such quick manipulation of the guns by the pointer as is necessary on a ship which is rolling several degrees.

Consequently the rapid success which has attended the attacks of the allied fleets is causing great surprise. Indeed, it is difficult to account for it, except on the ground that the heavy guns of the Turkish forts are of old pattern and low velocity, and the work of the gunners is far below the standard which has been reached in naval gunnery.

There are two stages of progress—first the night operations of a fleet of destroyers and lighter cruisers in removing the mines in advance of the battleship fleet. When a stretch of the strait has been cleared, the fleet moves forward, and, at a predetermined distance, steams to and fro, raining shells from its ten and twelve-inch guns until the forts are breached and the guns dismantled. If the allied fleet succeeds in forcing its way through the strait and reaching Constantinople, the exploit will constitute the most brilliant feat of its kind in the history of naval warfare. With Constantinople under the guns of the fleet, its fall is certain. With its fall, the era of Turkish rule, or rather misrule, in Europe will have closed forever.

Overcrowding and Health

IN the controversy between the Health Commissioner of this city and the Chairman of the Public Service Commission, on the subject of overcrowded cars, the sympathies of the public will naturally be with the Health Commissioner. The Board of Health in the exercise of its undoubted right to forbid the conduct of any business in a manner which constitutes a nuisance prejudicial to health, has called upon the Public Service Commission to exercise its authority over the transportation companies and prevent injurious overcrowding on two crosstown surface lines in this city. The Commission has replied that the overcrowding can be prevented only by hanging out a sign indicating that the car is full, as soon as the occupants number 50 per cent in excess of its seating capacity. This would be to adopt, in principle, the continental system of displaying a sign as soon as every seat is occupied, thereby indicating that no more passengers can be taken. In view of the enormous number of passengers traveling day by day in this city, and the rush with which the city's daily life is carried on, we believe that there would be a public outcry against the adoption of any such system—and this for the reason that rather than wait for a seat, the average American traveler is willing to undergo the inconvenience of "strap-hanging."

But, as the Board of Health points out, there is another and better way in which overcrowding can be prevented, and that is by putting more cars into service during the hours in which the worst crowding occurs. It is the practice of the transportation companies, and especially of the subway operating company, to cut down the size and number of trains between the rush hours. If this were done judiciously, there could be no objection to the practice; but almost invariably the reduction in the number and frequency of trains is such as to cause overcrowding to continue throughout the whole day. The same conditions exist on many of the surface lines, both in Manhattan, the Bronx, and Brooklyn.

The Board of Health is certainly within its rights in drawing attention to this unnecessary crowding, and the irritation shown by the Public Service Commission in its reply to the order of the Board of Health seems to indicate that the former body has not gone very wide of the mark in calling the Public Service Commission to account. It is the duty of the Commission to keep in very close touch with transportation conditions, and particularly should it watch this matter of overcrowding. When the Board of Health considers that the overcrowding has reached the point at which the health of the traveling public is so greatly endangered as to call for a definite protest against the practice, the public may rest assured that the danger is a very real one and that the possibilities of infection and contagion due to the herding of people in confined spaces for a long period of time are a positive menace.

The present commissioner of the Board of Health is held in very high repute in his own department, which is thoroughly in accord with him in the protest which he has made. The Public Service Commissioners were appointed to their very lucrative positions in order that the interests of the traveling public might be thoroughly safeguarded, and now that the menace to the public health due to overcrowding has been brought to their attention by so high a technical authority as the Health Commissioner, the public will hold them to account if they fail to do everything that is in their power to remedy the existing conditions.

Plant Autographs and What They Mean

THE dramatically interesting investigation outlined in the article on Plant Autographs appearing elsewhere in this issue is highly significant. It was conducted by Prof. Jagadis Chunder Bose as a continuation of a remarkable series of studies which culminated in positive proof that inorganic matter is as responsive to crucial electrical tests as organic matter. In other words, there is but one matter, whether it is living or non-living. The investigation described proves that there is no difference between plant and animal life in response to environment, and that the barrier long supposed to exist between the two is purely arbitrary. If all matter is alive, if it is wrong to set up barriers between the living and the non-living, surely we must speak not of "sciences," but of "science." There is but one matter, one science, one truth, and all outwardly different matters, all sciences and all truths are part of a great unity. It is poetically fitting that this should have been taught by a descendant of Hindu philosophers, who arrived by sheer speculation at conclusions which he has verified with the objective methods of modern science. In this remarkable investigation, therefore, the synthetic intellectual methods of the East co-operate with the analytic methods of the West in a single mind. In science, at least, all nations meet on a common ground of understanding, although half the nations of the world are at war.

Panama-Pacific Exposition Notes

Many Associations to Meet at the Fair.—Nearly four hundred State, national and international associations have already signified their intention to hold conventions at San Francisco during the fair season, and for these ample accommodations have been made. Most of these will be held in the big Convention Hall on the grounds, but there will also be many important and interesting gatherings in the State buildings, a number of which have made provision for such meetings.

Statistics of Numbers and Weight.—The total weight in exhibits handled by the traffic department is 80,000 tons. This hardly conveys an adequate idea of the immensity of the exhibit scope, although speaking roughly it would approximate a ton for each exhibitor. The gross of tonnage measurement is 500,000 tons. The number of individual packages, bales, crates and boxes handled runs so far over a million that additional figures would lend little emphasis.

Guarding the Roses.—Exposition guards have already been established to keep careful watch over the growing rose bushes that have been entered by famous growers of the world in competition for the $1,000 prize for the best rose, hitherto unnamed and never before exhibited, which can be produced. This rose, when the award is made, will be given a name that will pertain to the exposition, thus perpetuating the name and the glory of the exposition through the medium of a lovely bloom.

Arrangement and Appearance of the Fair.—The Panama-Pacific Exposition occupies a space of 2½ miles along the water front of the Golden Gate, nestling at the foot of a range of hills that forms a fitting background for the picturesque collection of buildings, which, with their domes, spires and minarets, is suggestive of some old time oriental city. By day the varied colors of the buildings against the verdure of their settings present a scene of harmony, while by night wonderful effects produced by the flood of electric light, ingeniously diffused throughout the grounds, are entrancing in the extreme. The exhibition buildings occupy the center of the scene, as viewed from the bay; to their right are located the buildings erected by the different States and foreign countries represented at the fair, together with race track and fields for aviation and out-door sports, while the left hand portion of the grounds is given over to the amusement features, a region known as the "Zone."

Bewildering Array of Articles Sent.—From the safe custody and transferring of three grains of radium, swathed in protecting coverings and guarded jealously, to the handling of the 1,500-ton exhibit of the United States Steel Corporation the details of installation have run the scale of the multifarious articles of art, industry, commerce and general activity. Eucalyptus trees a hundred feet in height and a foot thick at the base, palms from Cuba and South America with a 24-foot spread and a 4-foot base, orchids from the Philippines, from Australia and the Netherlands, works of fine art by world masters, ceramics from Italy and porcelains from Austria and satsuma and faience from Japan—perishable and imperishable, breakable and unbreakable; live beavers from Idaho and stuffed elk from Canada, big and little articles of dress and fabrications beyond price, all have had their day with the elaborate organization in charge of traffic. They all came jumbling and tumbling through the great arteries of transportation that led to the exposition grounds, but they went their separate ways through the finer capillaries until the minutest corpuscle was distributed to the smallest cell waiting for it.

Installing the Exhibits.—Four thousand workmen, working three shifts a day, a half dozen engines hauling box and flat cars of exhibits directly into the exhibit palaces, automobile trucks by the score and drays by the hundred, swinging derricks and whirring winches by the dozen combined during the few days before the opening of the Fair to present a scene of high pressure activity at the grounds of the Panama-Pacific International Exposition. The work of installing the myriads of exhibits was something that few people can imagine. Naturally the exhibitors delayed sending their consignments until the last moment, so that when they did begin to arrive there was an avalanche from every quarter of the world. Countless crates, cases and bales flowed in both by rail and by water, and except for an elaborate and efficient system of sorting and distribution, that had been carefully worked out by the management utter confusion would have arisen, for it must be remembered there are 80,000 exhibitors represented on the grounds. A system of tracks led to and into every exhibition building, and by means of these the car loads of freight, which the railroad companies transferred on floats directly to the exposition docks, were quickly and without confusion run to the particular building to which the exhibits were consigned. Once there, powerful cranes were ready at hand to unload and place the heavy pieces directly in their places. Steamships from foreign lands docked at the same place, and their cargoes were similarly handled.

Science

To Remove Garlic Flavor from Milk.—Recent investigations in the Dairy Division of the U. S. Bureau of Animal Industry have proved that the flavor of garlic may be entirely removed from milk by blowing air through it while it is held at a temperature of at least 140 deg. Fahr. An exposure of 30 minutes at 145 degrees is sufficient to free milk from the most objectionable flavor. A somewhat longer exposure is necessary for cream.

Hardy Spineless Cacti.—The U. S. Bureau of Plant Industry reports that in the course of its explorations in the southwest in quest of new species and varieties of cacti, three species have been found which promise to be of much economic importance. They are remarkably smooth and remain so under cultivation, grow rapidly, and will be hardy in the San Antonio and Austin regions. With the aid of these new forms in breeding operations it is hoped to increase the cold-resistance of the ordinary spineless species from 10 to 15, or possibly 20 degrees.

The Gypsy and the Brown-tail Moths.—The U. S. Bureau of Entomology reports encouraging progress in its fight with these formidable pests. Both insects have conspicuously decreased in numbers, especially the brown-tail, which suffered severely from the weather of last winter and from the work of the brown-tail moth fungous disease and imported parasites. The Bureau prepared colored posters illustrating the gipsy moth and its natural enemies, and these were posted in all postoffices and town offices in infested districts. Post cards bearing the same illustrations were distributed by mail and by the Boy Scouts.

Relation of Malaria to Agriculture.—An intensive study of the decrease of productiveness in an agricultural community due to malaria has been made by the Bureau of Entomology in Madison Parish, La. It was found that 12 families, cultivating 246 acres of land, lost an aggregate of 88 weeks during the crop-growing season from this cause, or more than 7 weeks per family. The financial loss in this case was estimated at $24 per family. Where the boll-weevil prevails the losses would be much heavier, as failure to keep up the cultivation of the crop or to plant at the proper time gives the weevil a decided advantage. It is clear from these investigations that the present loss through malaria in the southern States amounts to many millions of dollars.

The Cotton-boll Weevil, according to a report of the U. S. Bureau of Entomology, has changed somewhat in structure since entering the United States, and has also become adapted to greater severities of climate. Moreover, it is now able to obtain subsistence and possibly to develop on certain plants related to cotton, among them being *Hibiscus syriacus* and *Callirhoe involucrata*. In some of the mountain canyons of Arizona the weevil has been found on the so-called Arizona wild cotton, *Thurberia thespesioides*, and this western form of the insect shows even greater adaptivity to climatic extremes than the eastern variety. Hence considerable fear is felt for the success of western cotton growing, and the Bureau of Entomology has been making a special study of the situation. During the year 1913 the weevil spread over 17,700 square miles of new territory in the United States, and caused a primary loss in production of the area planted in cotton in that year of about $30,000,000.

A Humane Aigrette Industry.—The latest "Webster" dictionary says of aigrettes that "they grow only during the breeding season, so that in obtaining them not only are the parent birds killed, but the young are left to starve. The egrets producing them are therefore fast becoming extinct." While this statement is true of the aigrette industry as heretofore generally conducted and the cruelty of aigrette hunting has led to widespread legislation intended to discourage traffic in these feathers, it appears that a perfectly humane method of obtaining the latter has been evolved in India. In the *Journal of* the Bombay Natural History Society Mr. George Birch, assistant commissioner of the province of Sind, reports that egrets have been very extensively domesticated in that province. The birds are bred in captivity, and are plucked of their "ospreys" or aigrettes without suffering any injury, just as in the case of ostriches. The conditions of captivity make them more productive of aigrettes than are wild birds, as the young are taken away from their parents, to be reared by hand, when about a week old, and the parents then breed again. Thus the nuptial plumage, which is all that is commercially valuable, is assumed four times a year. The birds are liberally fed with fish, and are so tame that they allow themselves to be seized without showing any fear. The killing of egrets for their plumage was prohibited in the province about 30 years ago. The practice arose of snaring the birds and keeping them in captivity, but this led to the cruel custom of stitching up the birds' eyes in order to prevent their escape. After the authorities put a stop to the latter feature of the industry, egret farming became so humane and legitimate a business as to render unnecessary and unreasonable the present law against shipping the feathers out of India. The industry has become extremely profitable.

Aeronautics

Explosive Darts Against Zeppelins.—R. F. Robertson, of Dublin, Ireland, has just perfected an invention designed for the destruction of Zeppelin balloons by aeroplanes. He is said to have received a large order from the French and British army departments. The invention consists of a steel dart, fitted at its rear with fish-hook-like projections. The dart is hollow and contains an explosive which burns with a fierce sharp flame. When such a dart is dropped from an aeroplane upon a Zeppelin or other gas balloon, the hooks catch in the fabric after the point of the dart has pierced it and the explosive charge is ignited by the pulling backward of a friction detonator. As the explosion takes place inside the gasbag its effects are expected to be disastrous.

Sperry Experiments with His Stabilizer.—Lawrence Sperry has lately been experimenting with his automatic flying boat around New York, and among other things has tested the automatic volplane device in connection with the gyroscope control. It is reported that this is a small instrument resembling a windmill, which acts upon an electric switch, putting into action the auxiliary motor that works the controls. The action obtains only when the windmill's speed is reduced through the slowing of the aeroplane by engine stoppage or other cause when the elevator is operated to head the craft downward. A curious accident occurred during one flight, when a small sheet copper patch on the propeller loosened and was shot through the hull of the boat, causing a leak.

Eight-cylinder Motors Exported.—How quickly the American 8-cylinder gasoline motor has forced its way to the front, is plainly shown by the fact that one of the latest types of this motor is used in certain hydro-aeroplanes, which have been ordered by the Allied governments. The motor in question is the Hershell-Spillman engine, which is being used in at least two of the 1915 models of motor cars. Its flexibility, power and lightness have served to draw attention to it as a probable motor for aeroplanes and hydro-aeroplanes. It is reported that the German government has lodged an official protest against the manufacture and export of these motors to the Allies. The protest was disallowed, and the motors are now being installed in hydro-aeroplanes at Hammondsport, N. Y.

$5,000 for Army and Navy Airmen.—When Glenn H. Curtiss took part in competitions he found that trophies were great incentives to good work, and to promote healthy emulation and to aid in the development of aeronautics in the army and navy he has not only offered a trophy worth $5,000, to be competed for annually, but will give five purses of $1,000 each to those accomplishing the best results. These prizes are offered through the Aero Club of America, and the rules of the contest will be arranged by a committee composed of members of the club and of the army and navy. That some encouragement is due to the progressive men in the Government service will be appreciated when it is pointed out that the appropriations made for aeronautics for the coming year by the United States Government will not permit of the maintenance of more aeroplanes than Montenegro or Turkey has.

Seaplanes for the Navy.—Bids on the first open competition for hydro-aeroplanes for the United States Navy were opened on February 27th, and the department was much gratified over the fact that fifteen concerns participated. Six machines are required, and the general specifications call for biplanes of a sea-going type to carry two persons, guns, ammunition, wireless outfit, and a certain amount of armor. A speed of from 50 to 80 miles per hour is required, and they are to weigh between 2,500 and 3,000 pounds, with an average carrying capacity of 600 pounds. All information as to the plans and details of the proposed machines is refused, so that any comparison of the bids as submitted is impossible. The following is a list of the bidders, and the prices named by each for a single machine. It will be noted that the Gallaudet Company bids for but a single machine, and the B. F. Sturtevant Company and the Tygard Engine Company put in figures for the power plant alone.

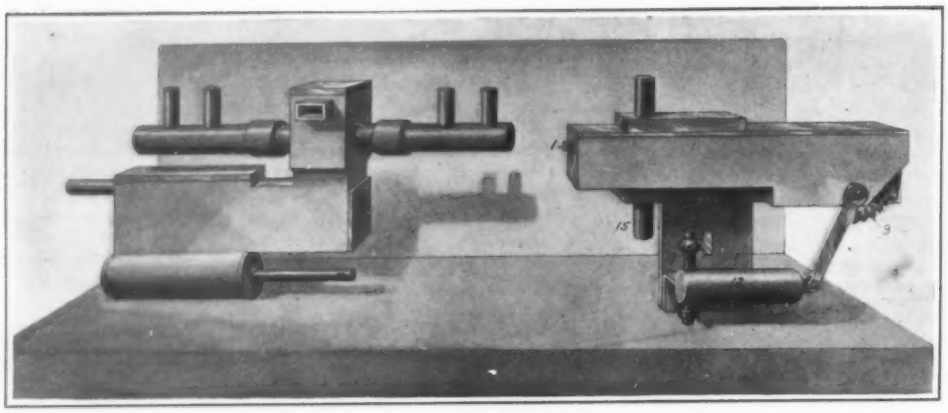
Aircraft Company, Inc.	$12,820
The Burgess Company	11,005
The Curtiss Aeroplane Company	17,925
Gallaudet Company, Inc.	18,000
Grinnell Aeroplane Company	15,000
William C. Hurst	11,000
Peopli Aeroplane Corporation	7,300
Shaw Aeroplane Company	8,500
The B. F. Sturtevant Company (motor only)	4,325
Thomas Brothers Aeroplane Company	8,900
E. Thomas Brothers Aeroplane Company	12,980
The Tygard Engine Company (motor only)	14,000
The Wright Company	15,000
B. Stephens & Son	6,600
G. H. Armitage	8,350
A. M. Herring	6,900

The specifications under which the bids were submitted included a number of heads, and it will require some time to classify and consider the figures contained in the bids.

A Machine That Remembers and Forgets

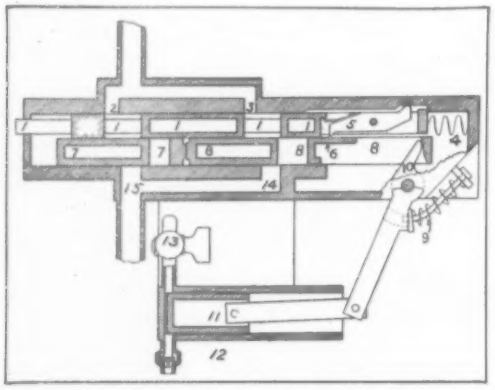
By W. H. Dearden

A MACHINE that can learn things and then will forget them if it is not kept in practice, that can form habits like a living being, and is, in fact, intended to imitate the memory processes of life itself, has actually been invented and built. It is now attracting the keen interest in the small circle of scientists who know of it. Because it has a memory like a brain, very limited, of course, but astonishing enough even at that, it might be called a "brain machine."



Transmitter (on the right) and receiver (on the left) of the remembering machine.

An example of what the brain-machine could readily be made to do will show its marvel. Any electrical student could construct a little apparatus which would move toward the warmth of a fire and then would move back again when it came so close that the heat was excessive. Such an apparatus, not at all wonderful in itself, could be attached to this brain-machine and the wonders would begin. If a fire was placed near the machine it would move toward the heat, like a little child or an animal who felt cold. When the machine came so close that the heat was excessive, it would move back like a child or an animal who had come too close and suffered a burn.



Mechanical brain of the remembering machine.

After one or two such experiences, the brain-machine would have learned its lesson. If fire were then placed near it, it would not move up; in fact, it would probably back away as if it were afraid of being burned. Again and again the experiment might be tried, and the machine would keep away from the fire. However, let the machine rest for awhile, say over night, and it would forget. Then, if the fire were placed near it, the machine would move up and again be burned and jump back. This would teach the lesson again, and the "habit" of not being burned would have again been acquired, but only frequent experience would keep the machine from forgetting.

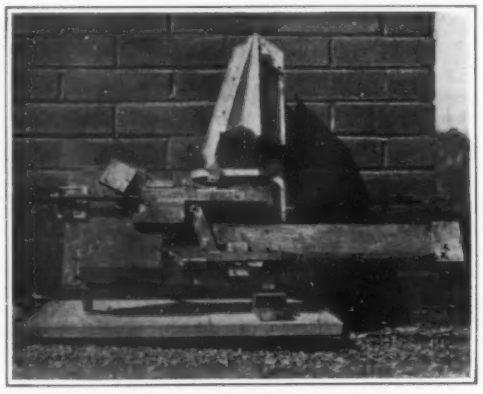
The inventor of this curious apparatus is not a visionary dreamer, but a practical mechanical engineer, S. Bent Russell of St. Louis. He has become deeply interested in the whole science of nerve and brain study. The idea came to him that the engineering profession has so far contributed little or nothing to brain study, and yet probably has much valuable knowledge that could be used there, and so he determined to help the psychologist by constructing a mechanism which had associative memory, thus proving that associative memory, at least in some form, could be a matter of mechanism.

It is a simple process of the nervous system which Mr. Russell sought to imitate. If an impulse proceeds along one nerve channel in an animal, and then, when it gets to the end invariably it is followed by a second impulse along a second channel, and this sequence is repeated often enough, there will soon be what might be called a short-cut channel from the beginning of the first impulse to the end of the second impulse; the starting of the first impulse will be enough to cause the second action. An essential part of the machine is a valve which will open wider the more often it is used and the more recently it has been used. This valve is the ordinarily dull nerve channel that develops into an active open channel with frequent use. Compressed air may be used for power, and thus with the use of this valve the amount of power applied at one place depends upon how often the power is applied to that one place, and how recently. If the power is applied often the valve opens wide and acts at that one place surely and effectively, but if it is applied seldom, the valve only opens slightly, and most of the power will go to an entirely different spot and accomplish an entirely different result.

The diagram represents one of the transmitters of Mr. Russell's machine and shows its essential principle. The slide valve 1 is shown at the extreme end of its inward stroke, or stroke to the right, as in receiving a signal, and this is known as the spur valve. When it is in this position it opens ports 2 and 3 to admit pressure (in this case we shall assume that hydraulic pressure is used). It is the final destination of the water entering ports 2 and 3 that determines what action shall follow an impulse. The spur valve spring 4 is now compressed. The pawl 5 which is attached to the spur valve is pressed by a spring into engagement with the ratchet 6. Valve 1 slides over the lag valve 7 and the ratchet valve 8.

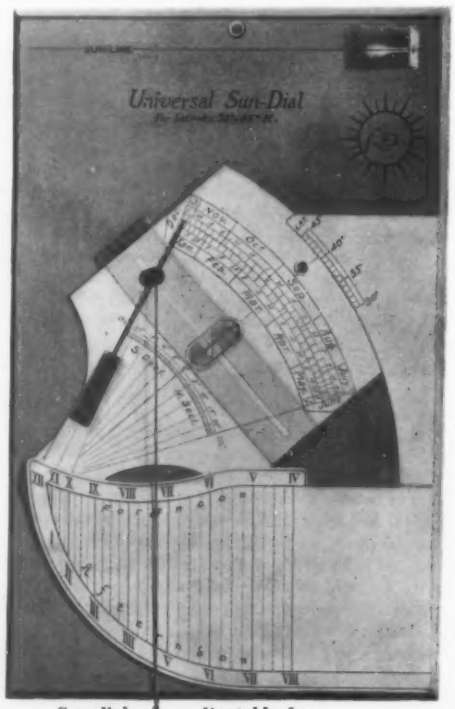
The ratchet valve 8 is shown in the figure in its original position or right-hand end of its stroke. When valve 1 is permitted to make its return or outward stroke the valve 8 moves also, pushed by pawl 5, but valve 8 cannot move far, as the pawl is soon tripped by the lug on its top striking the casing. When the ratchet valve 8 is thus released, it moves back to the right, driven by lever spring 9, acting through the rocking finger 10. As this action is taken, the dashpot plunger 11 is driven back by the force of this same spring 9; and conversely, when valve 8 slides to the left, it sucks air into dashpot 12 through a check valve, and this air can only pass out through adjusting cock 13. In this way the return stroke of the ratchet valve 8 is very slow, being controlled by the speed of the air passing out of 13. If the time interval before a second stroke of spur valve 1 is long enough, ratchet valve 8 will have reached its original position, and its second stroke will be the same as the first and lag valve 7 will not be moved. If, on the other hand, the time interval is so short that the second stroke of the spur valve comes before the ratchet valve has arrived at its original position, the ratchet will cause the ratchet valve to advance farther to the left than before, and hence the lag valve will be advanced farther to the left. Now, the farther valve 8 moves to the left the greater will be the effective opening for water pressure from port 3 to issue port 14. Hence, the effective opening at any stroke will be in inverse proportion to the time interval since the last stroke. In other words, the passageway will gradually close between strokes. In the case of the lag valve 7, the farther it moves to the left the greater will be the effective opening for water pressure from port 2 to issue port 15.

Its application to the idea is simple. The more often the spur valve 1 is operated back and forth the bigger will be the opening through 3 and 14, or the more active will be this nerve channel. The size of that opening is controlled by valve 8, and it will be seen that the forgetting part of the machine is the dashpot 12. When the plunger 11 is pushed all the way in, the machine has forgotten. When it is pulled out, the machine remembers, or keeps the 3-14 channel open. By allowing the air in the dashpot to escape slowly through 13, the time in which it takes the machine to forget can be controlled.



A modified form of the "brain" machine.

In combining a number of these units together some more ingenious mechanism has been made, but the unit is the essential principle.



Sun-dial adjustable for various latitudes.

Universal Sun-dial

IN the SCIENTIFIC AMERICAN of August 10th, 1912, we described a sun-dial similar to the one shown in the accompanying engraving, but which, unlike this one, was not adjustable for various latitudes. For the benefit of those who did not see the original article, we will explain that, in use, sun-dials of this type are swung in a vertical plane until the shadow cast by the gnomon falls on the "sun line." In the present case the gnomon shown in the upper right-hand corner, contains a keyhole slot, and the sun-dial is adjusted to center the light shining through this slot, upon the sun-line. Then the time may be determined by noting where the plummet line crosses the forenoon or the afternoon hour line, as the case may be. Of course the point of attachment of the plummet line must be adjusted for the day of the year, as a moment's consideration will prove. At sunrise and sunset the shadow of the gnomon is horizontal, and the plummet line must lie parallel with the lines connecting the forenoon and afternoon hour curves.

But in the latitude of New York, for instance, the sun sets at about 4:30 in December and 7:30 in June. Evidently then the plummet should be hung from different points at different times of the year. To provide for this adjustment, the sun-dial here shown has a sector graduated with a date scale, and a pointer carrying a button to which the plummet line is attached. As the pointer is moved to the date on which the observation is taken, the button which slides freely on the pointer and also in a slot cut in a celluloid plate, travels on a straight line instead of a curve. The arrangement is such that the plummet is adjusted for the variations of the sun's declination at different days of the year. The actual value of the declination may be read on a scale on the sector. If this sun dial is to be used in more than one latitude, a further adjustment is necessary. This is provided by making the sector movable with respect to a latitude scale. Our illustration shows the sector adjusted to latitude 40½ degrees. The celluloid plate must be set with its slot centered over the point where a center line of the sector crosses a fixed vertical line. Thereafter the pointer may be set for the date and the sun-dial may be used as described above. The inventor of this ingenious sun-dial is Mr. W. Leinert of New York city.

"Sweeping"—Another blind alley occupation.

The regular grade school has been unable to develop these boys.

The Educational Scrap Heap and the Blind Alley Job

The Need of Opportunities for Working Youth

By L. W. Dooley

A MATTER that is of great economic and vast sociological importance is the rapidly growing army of the unemployed, the great majority of whom are not qualified to fill positions requiring skill or special training, and yet lack the education necessary to enable them to undertake anything but manual labor. That the source of these conditions lies in our educational system is explained in an article in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT by L. W. Dooley, who discusses the subject at length and makes practical remedial suggestions. An outline of this article is given in the following paragraphs, and it is evident the article is well worth the attention of all interested in sociological conditions.

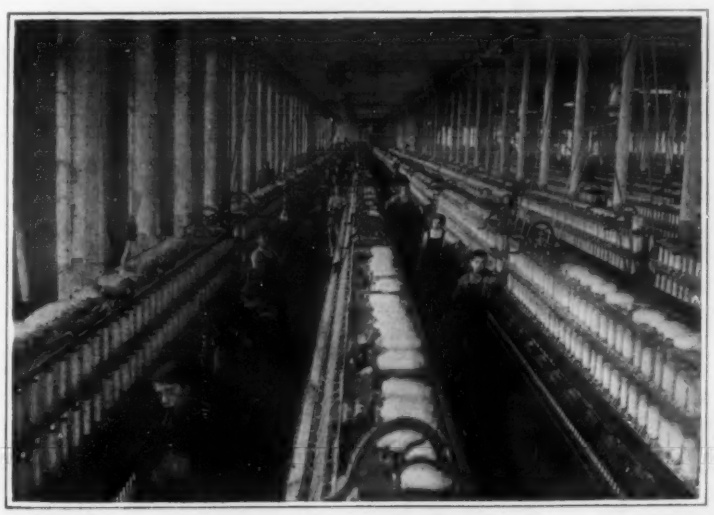
Waste is repugnant to us to-day. This same cry of greater efficiency of the modern time has entered our educational system. Citizens and public spirited men are criticising our schools through the newspapers and magazines. They claim that there is great waste in our schools, the essential is neglected, and the boys and girls are not properly prepared for life. The practical abandonment of the apprenticeship in the country, except in a few isolated places like Brown & Sharpe Manufacturing Company, is bringing about a want of skilled workmen which the modern industrial system is failing to supply. On the other hand, the great number of unskilled workers have increased, and all of them have not been able to obtain employment. The great industrial demand of the present and of the recent past is making this want felt more and more sharply. The whole country is awakening to the necessities of the case and demanding a remedy. Organized educational forces are moving rapidly in the direction of making our school system more practical. There can be but little question that our school system has lagged behind the development of those forces of business organization with which they should be clearly articulated. Our school system is only just now entering upon the stage of efficiency which industry has long since considered. Nowadays educational experts are beginning to see that the dull pupils can be rescued and that stupidity has various causes, a great many of which may be cured. In years gone by, if a girl or boy did not get on well in school, he or she was most likely noted as being just plain stupid, and called a dunce, and allowed to drag along until the day came when they would leave school. These children have been referred to as the scrap heap of the public school system. This educational scrap heap, designated by our present school system as worthless, has great imitative power and capacity for mechanical work and experiences no difficulty in obtaining work at a high initial wage in what are called by our social workers "blind alleys" or "dead end" employment, that is, employment such as messenger boys, attendants in bowling alleys, doffers in mills, attendants in glass factories, etc., in which the experience gained under the present industrial and educational conditions is said to form no basis for advancement into more skilled and better paid work as the child grows older. When these young men reach the age of eighteen they have passed their usefulness in this type of juvenile work, and find there are not positions enough for them in other parts of the mill, and they leave and form our great unskilled army.

Training for a skilled trade.

In order to reduce our so-called educational scrap-heap it is necessary to change our school system so that it will educate the whole boy and girl of this day. A manual training department should be attached to every school in this country. Children should be taught as soon as they go to school to use their hands, as the father and mother did in the rural communities a generation ago.

We must act on the principle admitted by everybody who knows or cares anything about education, that the way to secure a good training for the mind is not to end the school life at the most plastic period, fourteen years of age, or in the case of foreigners, as soon as they can pass an examination, but to insist that every boy shall spend a certain number of hours a week under educational training and sound teaching till he reaches manhood.

In order to overcome the educational weakness of our present dead end or blind alley occupations, we must provide opportunities for working youths on a part time system, an education which will meet with their interests and tastes, assisting each to become proficient in some line of work that he may enter after passing his usefulness in the so-called blind alley position. Our public school system should audit our social accounts and publish the opportunities available to young people, that they may choose their life work scientifically, and in this way reduce our scrap-heap of unskilled labor to a minimum. Blind alley jobs will then become ports of entry into more skilled and profitable positions.



"Doffing"—A blind alley occupation.

Toothbrush Holder and Sterilizer

THE man who cares to subject his toothbrush to a microscopic examination will find that even though his teeth and gums are in sound condition, the bristles of his toothbrush will be swarming with millions of organisms. This filthy condition can be kept down to some extent by the use of antiseptic toothpowders and pastes, but a still more effective method has recently been devised, which will render the brush absolutely sterile. The handle of the brush is made hollow and can be unscrewed from the brush proper, forming a receptacle into which the brush may be inserted. Inside the handle a disinfectant is kept which will sterilize the brush. The brush sealed in its hollow handle makes a very convenient package for travelers who now have difficulty in keeping their brushes out of contact with dirt.

The Supreme Court and Unfair Competition.—The Supreme Court in the case involving L. E. Waterman Company and Modern Pen Company among other things said that when the use of his own name upon his goods by a later competitor will and does lead the public to understand that those goods are the product of a concern already established and well known under that name, and when the profit of the confusion is known to and, if that be material, is intended by the later man, the law will require him to take reasonable precautions to prevent the mistake.

The Commissioner of Patents on Compulsory Licenses *

THERE is agitation growing largely out of the conditions created by the war, in favor of the introduction of compulsory license and compulsory working of patents in this country.

The embarrassments of the present situation are perhaps most keenly felt in the dye and drug trades. I shall not undertake to minimize the difficulties, but they certainly do not all arise out of our patent system. The difficulties are economic. They are very acute in Great Britain in spite of provisions of her patent system which we are urged to adopt. If all of the patents now held by Germans and not worked in this country, relating to chemicals used in these two trades, were thrown open to the public, it would involve a large investment of capital to prepare to manufacture these chemicals here. At a conference held in the office of the Secretary of the Interior shortly after the war began, the statement was made by an expert in the dye trade that it would require about $100,000 of investment per color to supply the market of the United States with dyes. The point was made then and has been frequently made since, notably in the *Journal of Industrial and Engineering Chemistry* of November, 1914, that protection against resumption of competition from Germany, in excess of what is now provided by the Tariff Act, is essential. I shall not discuss the tariff, but limit my discussion to proposed changes of our patent laws.

The first thing to be considered is that compulsory working, revocation, and compulsory license must be made applicable to all patents granted in this country. It has been proposed to limit them to patents granted to foreigners. We had a somewhat similar provision in our law from 1836 to 1870. But the entire body of treaties known as the International Convention which have been negotiated since that time are based upon the fundamental provision of Article 3, that "The subjects or citizens of each of the contracting countries shall enjoy in all of the other countries of the union . . . the advantage which the respective laws now grant, or may hereafter grant, to the citizens of that country." This article embraces not merely patents of utility and design, but also trade-marks. Any departure from this convention would render nugatory the work looking to enlargement of trade which has been done in connection with these treaties during more than thirty years. In addition to the International Convention, we have a special treaty with Germany, proclaimed August 1st, 1909, which has been liberally construed by the German courts in favor of American citizens. We may, I think, therefore dismiss all suggestions that these new provisions be limited to foreign patentees.

A recent report transmitted by our Consul General at London, dated October 22nd, 1914, states that at the end of 1912, after the Act of 1907 had been in operation in Great Britain for five years, about $50,000 per week was being paid in Great Britain as wages in factories established because of the compulsory working features of that Act, and that by the end of 1913, $10,000,000 had been spent for factories and equipment. This sum divided over five or six years is not very impressive, but leaves ample room for the argument that the disturbance of the patent system introduced by this compulsory feature outweighs the pecuniary advantages assuming the latter to be entirely genuine.

In Great Britain a curious result has been evolved by judicial construction. Among the cases reported in the *Illustrated Official Journal* is that in the matter of Hatschecks's patent (1909 *Journal*, page 228). Here Mr. Justice Parker held that the question is not whether the market of England is supplied mainly or satisfactorily by manufacture of the invention conducted in England, but whether England as one of the great commercial nations of the world is enjoying her fair share in the manufacturing and marketing of the invention. See what a vast field such a conclusion opens. The endeavor to investigate the trade of the industrial world in any patented article, and the question what proportion Great Britain is entitled to in view of her standing as a manufacturing nation, would involve, if adequately gone into, a record which would make the Selden record look like a Webster's spelling book alongside of one of his unabridged dictionaries.

In an address before the Board of Trade last June, Mr. Levenstein, to whose efforts the passage of the requirement of the compulsory working was largely due, while claiming that the prospect of benefit from this section was bright at the start, frankly admits that it has been a failure. He attributes this not to the difficulty which I have pointed out above, but to an opinion expressed by Mr. Justice Parker, also in the Hatscheks case, to the effect that the burden of proof that the manufacture is carried on mainly or exclusively outside of the United Kingdom must be borne by the petitioner for revocation. Mr. Levenstein says: "The mischief, if I may call it so, became at once apparent. While we had about seventy-three applications up to the end of 1909, there was one patent revoked in 1910, and in this instance I suppose it was revoked because of no defense. In 1911 no proceedings were reported. In 1912 there was one application, and in 1913 there was one revocation."

In Germany during earlier times they had a drastic compulsory working enactment, but since 1911 the working clause has been substantially identical with the clause in the British statute. I am not informed specifically as to how it has worked in Germany. But DuBois Raymond, an eminent German authority, in his paper published in the Report of the Investigation of the United States Patent Office (1912, pages 434-435), says: "I do not know of a single instance in which a firm, to comply with the working clause of a foreign patent law, has started a *bona fide* work shop to supply the market of the country governed by such law, and it stands to reason that in the great majority of cases it would be commercially much more rational to abandon the foreign patent and endeavor to maintain, without patent protection, whatever footing in the market had been gained."

As to the compulsory license provisions of Germany, Great Britain, and Canada, it is a well-known fact that up to the time of the outbreak of the European war, at any rate, they have not been applied. Dr. Osterrieth in his paper published in the Report of the Investigation of the United States Patent Office (1912, page 379), states that this clause in the German law proved most ineffective, "as no single case of revocation on this ground has been known." In Great Britain almost no applications have been made for compulsory licenses. There is no such case reported in the whole volume of the *Illustrated Official Journal* for the year 1909. Later reports show that the same state of affairs existed down to the outbreak of the European war. In Canada also no compulsory license has ever been granted.

One reason unquestionably is that without the free co-operation of the inventor and patentee, it is impracticable to operate under a license because of the difficulty of manufacturing on a commercial scale anything with the development of which one is not familiar.

There is another objection which is, I think, even more important. If a compulsory license provision is to be effective it means a new class of litigation respecting property which is almost fatally burdened with litigation under present conditions.

If it is not to be of any practicable effectiveness, it of course should be avoided. It will necessarily reduce the value of patents. The mere prospect of increased litigation would insure this result.

Moreover, the policy of compulsory license raises a question of the theory of compensation of patentees which I think will almost certainly result in great hardship. Let me cite, by way of illustration of my point, the famous drug known as "606." This number means that there had been 606 experiments, 605 of which failed to produce the desired result satisfactorily. This is an exaggerated case, doubtless, but it is characteristic of invention-development that the losses incident to failures which precede the final success are large.

Yet when the compensation of the patentee is to be determined, he must, in order to defend his property, present all of the failures and their bearing upon the development of the invention. The chances are far more than even that in the end the rule will be merely to grant fair compensation for the enjoyment of the final successful invention as if it had been struck off at a blow. It will certainly be very difficult to induce a court to grant return on what will be looked upon as junk.

* Address by the Hon. Thomas Ewing, Commissioner of Patents, before the American Patent Bar Association, February 20th, 1915.

Dr. Rittman's Gasoline Process

SECRETARY OF THE INTERIOR LANE recently announced the discovery by the United States Bureau of Mines of two chemical processes, one of which, it is claimed, will be of tremendous importance to the oil industry, greatly increasing the supply of gasoline, while the other will give the United States the important materials necessary for the dye industry and the manufacture of high explosives used in warfare and in engineering operations.

The first of these processes promises to enable the independent refiners in this country to increase their output of gasoline from petroleum 200 per cent or more. With an estimated production on the part of the independent refiners of 12,000,000 barrels of gasoline in a year, this will mean an output from the independents alone of 36,000,000 barrels, greater than the total production to-day from all sources.

The second process includes the manufacture from crude petroleum of what is known chemically as toluol and benzol, both of which have heretofore been obtained from coal tar. As Germany has specialized far beyond other countries in by-products from coal, the United States and the rest of the world have been dominated by that country as regards those products of toluol and benzol which are the important bases for the production of dye stuffs and high explosives, and especially smokeless powder.

The discoverer of these two valuable processes, after many years of research, is Dr. Walter F. Rittman, chemical engineer of the Bureau of Mines, the work having been done at Columbia University, New York, the facilities of the laboratory there having been turned over to the Federal Government by President Nicholas Murray Butler.

It is claimed by Dr. Rittman that his process is safer, simpler and is more economical in time than processes now in use, and these are economic factors of great importance. With a steadily increasing demand for gasoline for automobiles, motorboats, and engines, this fortunate discovery comes at the proper time. It is but two years ago that the automobile industry, fearful that the supply of gasoline might not be adequate for its rapidly expanding business, offered through the International Association of Recognized Automobile Clubs, a prize of $100,000 for a substitute for gasoline that would cost less than gasoline. Happily the urgency of this situation has passed and at the present time there is a plentiful supply of motor fuel to meet immediate demand. This new process adds to the hope, that in spite of the wonderful growth in the use of gasoline, there may not be any shortage in the future. It indicates an increased production of gasoline from the present production of petroleum—an output of 50,000,000 barrels instead of 25,000,000, as under the present methods. It will render free for use to all, the results of that efficient and intelligent research which has heretofore been only at the command of the wealthy. When it is realized that the gasoline industry each year in this country yields products amounting in value to between $100,000,000 and $150,000,000, the importance of this discovery is seen.

Among necessary ingredients of high explosives used in modern warfare toluol and benzol are in the first rank. Heretofore these products have mainly been obtained in Germany and England from coal tar, and the explosives manufacturers have had to depend largely on the supply from these sources in the making of explosives. Some toluol and benzol have been obtained from American coal and water-gas tars, but this supply does not begin to satisfy the present demands. The Federal Government now proposes to obtain the toluol and benzol from crude petroleum also. These products can be produced from practically any American petroleum by the Rittman process, and the supply can be made sufficient not only for the entire American trade, but also for other purposes. This process has gone far enough to indicate that the two products can be produced at a reasonable cost.

Dr. Rittman concludes from his experiments that this process may become more economical than the German method of obtaining these products from coal tar, as this process not only makes toluol and benzol, but also gasoline in considerable quantities. He has intimated the possibility of the value of the gasoline being an important factor in paying the costs of the process.

The Current Supplement

THE important subject of establishing a definite universal standard for determining horse-power and the making of accurate measurements of power is fully covered in the article on The Relation of the Horse-power to the Kilowatt in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2045, March 13th, 1915. The Rural School and the Hook Worm contains valuable information in relation to a subject of great importance. The Defense of Belgium by Inundation gives an interesting description of that portion of Belgium where the German advance was checked by the opening of the dikes. The Educational Scrap Heap is a most valuable discussion of one of the most important educational problems now confronting us. Gyrostatic Action describes a number of gyrostatic devices available for controlling moving bodies, especially as applied to aeroplanes, submarines, and automobile torpedoes. The use of a powerful electromagnet for removing particles of metal from wounds and the eyes describes an invention of great value both in peace and war. Deformation of the Earth by the Moon discusses a most interesting but difficult problem and some of the methods of solution. The consideration of police departments from an engineering standpoint is in the line of a more scientific and practical handling of criminal matters. The Strongest Vault in the World describes the remarkable structure that was installed in the new banking house of J. P. Morgan & Co. Theories about Thunder adds considerable information on a familiar subject. Some timely information in relation to trinitrotoluene, the explosive so largely used in military operations, and popularly known as TNT, is given in a short article; and there are notes on the comparison of the silver and iodine voltameters.

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

Why the Mail Bag?

To the Editor of the SCIENTIFIC AMERICAN:

The large amount of breakage and the needless crushing of many Christmas presents recently sent through the mail raises the question why the mail bag is retained by the Government. Express companies avoid much damage to packages by using common sense. Why should the Government retain this relic of the days of the pony-relay, this modified form of saddle bags?

Ferndale, Cal. A. G. GRANT.

Watering City Trees

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of December 12th appeared a description of a novel contrivance which is being used in Strassburg, Germany, for applying water to city trees in dry seasons. The method therein described—of bending a perforated iron pipe around the tree to be watered and then attempting to saturate the hard ground sufficiently for the needs of a large tree, by means of pouring water into a funnel and thence into the bent and buried pipe, pierced with small holes—all appears to be a most impractical and expensive method. Your correspondent has often had occasion to apply water to planted trees in an arid climate and he has been uniformly successful with the simple expedient of boring one or more holes with a post auger (avoiding all large roots) at a suitable distance from the tree, say 18 inches more or less, according to its age, and to a depth of 2 to 3 feet. These holes, if more than one is deemed necessary, should encircle the tree equidistant and be tamped full of horse manure mixed with light stable litter, which will be found to take up water by the bucketful as fast as it can be poured thereon, fertilizing and softening the ground all around the roots and retaining the moisture for a long time. A dab of hay can easily be added on top of any hole where settling takes place. By this means the roots will also receive an increase of moisture during rainy seasons.

Lawrence, Kan. M. SHILLERSTON.

Resin and Babbitting

To the Editor of the SCIENTIFIC AMERICAN:

Here is something that you probably know all about, but I know that a great many others do not, and to such it may be of great value, save time, and possibly prevent some serious accidents. As safety first is the great cry now, I give it to you either for publication or the waste basket, as you may deem fit.

While working on my first job as a millwright I had occasion to run some small boxes with Babbitt metal. In running one of them, when nearly full the hot metal exploded and I came near losing one of my eyes. Just then the boss millwright came around and said the cause was that there was water in the box. "And now remember as long as you work at this business that you can't run hot metal into a wet or damp box: it must always be absolutely dry or you run a great risk."

I remembered that advice and acted upon it for many years until I had all my knowledge knocked out of me by another who was not a boss.

On the last sawmill that I helped to build I was running some boxes and one of them happened to be right under the eaves, and it was a rainy day; I put a cover over the box, but the water would spatter in, and I did not dare to try to run it. I told the Dutchman that was working with me that we would have to leave that till some other time, for it could not be run. He said, "You run over to the store and get some resin and I will show you that we can finish the job now." I got the resin; he crushed some of it with his hammer and put it in the box that was now good and wet and said, "Now pour in your metal." This I refused to do. He took the ladle and turned in the metal, while I stood well out of the way. There was no sign of an explosion; not even steam. Since then I have run many, even if half full of water; put a little powdered resin on top and there is no danger of explosion. What is the reason? J. F. MILES.

Wisconsin Veterans Home, Wis.

Uncle Sam's Real Need

To the Editor of the SCIENTIFIC AMERICAN:

Your discussion of our military needs is extremely timely. The trouble is our extremists. One side clamors for "universal" military training or "the biggest navy in the world." The other side, with almost equal absurdity, deprecates any increase whatever. And the truth lies, as so often the case, about half way between.

Why emphasize a trained reserve of half a million? Simply because it goes straight to the point of vital need. For with such a force a serious naval defeat would not spell terrible disaster. As it is now, we've got practically nothing to back our navy up.

What do your pages, and those of your contemporaries, indicate as the probable size of an invading host in case of naval defeat? From 100,000 to 150,000 men, or a possible 200,000. But what could they *accomplish* if we instantly mobilized 500,000 to confront them, thoroughly trained for a year, say 50,000 a year till the total was reached?

Thereafter we would only have to keep the quota full and allow a fortnight for annual maneuvers, so officers and men might march and deploy in masses of one or two hundred thousand, in which, with our present corporal's guard of an army, they can have no training whatever.

We don't want a standing army, for reasons too familiar to mention, and we don't need the proposed three years training. With volunteers of the right stamp and training, one year will suffice.

On the other hand, we *do* require a force of the size stated, for the reason stated. We don't like the spirit of militarism. But if those 500,000 developed too much of that spirit there are already about 99,500,000 more of us to keep them in check. And there'll soon be several more. Besides, that reserve would not be a standing army, but merely a national guard to serve in case of foreign war, and, primarily, to repel invasion.

The other needs of the service, perhaps important but minor needs, will tend to take care of themselves, if we only meet the paramount need above referred to.

San Francisco, Cal. A SON OF UNCLE SAM.

Why Ice, in Refrigerators, Prevents Freezing

To the Editor of the SCIENTIFIC AMERICAN:

This problem was presented to my attention, the past winter, during a severe cold wave, which occasioned comment upon the matter of heat conservation.

At a recent convention held in Chicago the question arose as to why was fruit frozen in cars containing no ice, while in those containing ice, fruit was not frozen, even when the temperature was much below the freezing point.

That such results were literally correct was verified by many experiences, besides confirmed also, in a domestic way, as the freezing of contents in ice boxes when they held no ice, while when ice was stored in the box the contents remained unfrozen.

The industrial importance of such natural law will readily appear. I therefore advance an explanation which I feel satisfied will justify its acceptance.

The Chicago convention above mentioned failed to elucidate the matter, hence, as it was still a mooted question, I essay an answer.

In the first place, we recognize the physical fact that ice registers 32 degrees of heat, while all degrees below 32 degrees must obviously be colder and thus liable to freeze any body containing water in its substance. Thus, we get frozen vegetables and fruit in cars lacking ice when the temperature drops any considerable degree below the freezing point, whereas if ice is stored in that same car the fruit and vegetables are not frozen.

This, then, being true, we are confronted with the explanation which I wish to advance, viz.:

In the car containing ice the chill of the air is neutralized by the action of the ice when the temperature drops below that of the ice. This results from the release of latent heat as a result of congelation of vapor contained in the air, while the resultant ice, formed out of the vapor, will precipitate itself upon the ice just as rapidly as it reaches that body of frozen water; thus when the fresh ice is formed there is likewise a release of the latent heat of the vapor, amounting, at steam heat, to 536 degrees. Thus the air of the car is kept warm by the latent heat given up by the action of its contained ice upon the vapor carrying such hidden heat. This latent heat, thus released, is the warming agent which preserves vegetables and fruits from freezing in cars or refrigerators containing ice. The fruit and vegetables, while largely water, yet being in the form of organic compounds, will freeze at a lower temperature than pure water. JOHN D. BONNAR, M.D.

Buffalo, N. Y.

Integral Salts for Cold Weather Concreting

To the Editor of the SCIENTIFIC AMERICAN:

In the issue of the SCIENTIFIC AMERICAN for December 5th, 1914, there appears under the heading "Concrete Freezing" some statements covering the use of concrete in freezing weather, to which I should, in part, like to take friendly exception.

While it is true, as your writer says, that the use of chloride of calcium added to the mixing water will prevent the freezing of freshly deposited concrete, nevertheless the use of this substance, as well as the use of chloride of sodium, is not to be recommended for a number of reasons, and modern practice in cold weather concreting has so far recognized the validity of these reasons as to have practically ceased the use of integral substances for the purpose mentioned. Your writer says:

"It is a well-known fact that solutions of different salts are more difficult to freeze than pure water; for instance, a 20 per cent common salt solution only freezes at 14 deg. Cent. below the freezing point of water and a chloride of calcium solution freezes at a still lower point, or 18 deg. Cent. below. This phenomenon can be made use of in connection with concrete working, and such solutions are used when preparing the material so as to lower the freezing point. In this way it is possible to carry out work with concrete even during very great cold which would not be practicable by the ordinary process."

Experience seems to have proved that there is a practical limit to which chloride of sodium and chloride of calcium may be used, as an excess of either of these materials will affect the ultimate strength of the concrete. This limitation has made it impracticable to rely on chemical salts as a preventive of freezing for temperatures lower than 22 deg. Fahr. Hence, you can see the use of chemical salts does not, as your writer states, make "it possible to carry out work with concrete even during very great cold."

Your writer also says:

"It is better to use chloride of calcium instead of common salt for such work, as the former salt increases the waterproof quality of the concrete and is much preferable for this reason."

And further:

"Adding more than 2 per cent of salt (chloride of calcium) is found to increase the speed of setting, but it is remarked that concretes are less resistant as the setting is quicker, so that it is not well to go higher than the foregoing figure."

This last supports what I have already cited by way of objection.

Concerning the subject of increasing the watertightness of concrete, authorities now generally agree that the subject of watertightness is one largely, if not entirely, dependent upon proper grading and proportioning of aggregates combined with the proper proportion of cement, materials being mixed with enough water so that the resultant mass is of a so-called "quaky" consistency, meaning that there is just enough water to permit placing the concrete with slight puddling rather than tamping, yet not enough water to cause the sand-cement mortar to separate from the coarse aggregate.

By far the best precautions to use in cold weather concrete work consist of heating the materials used (excepting the cement) and protecting the concrete from freezing for a certain time after placing. Chloride of sodium and chloride of calcium used in safe quantities retard rather than hasten the hardening of concrete, while in winter work methods which will accelerate the hardening process are to be sought and practised.

As water is an element required to bring about the hardening of Portland cement, it is evident, first, that the water in concrete must be kept from freezing; as heat also hastens the hardening, it is evident that warmth is desirable. This suggests heating the mixing water to a temperature of at least 150 degrees, likewise heating the aggregates and mixing the heated materials so that the concrete when placed shall have a temperature not lower than 80 degrees; then at once providing suitable protection for the freshly deposited concrete so as to maintain as much of this added heat as possible for at least a 48-hour period. During this time, under suitable protection, the concrete will have hardened sufficiently to be proof against injury from possible freezing thereafter.

There are other objections that condemn the use of chemical salts. First, we may consider the trouble of efflorescence, otherwise described as "a whitish deposit appearing on the surface of concrete work and consisting of a substance principally free from lime carbonate." This results from the absorption of rain or moisture by porous concrete and the dissolving out of any solution salt present, which subsequently is deposited on the surface when evaporation takes place. Both sodium chloride and calcium chloride, being very deliquescent salts, will aggravate the trouble of efflorescence.

Second, recent investigations conducted by the Bureau of Standards, Washington, D. C., and contained in Technologic Papers No. 18, agree with general experience that salt and calcium chloride are especially objectionable in reinforced concrete work. Both act to corrode reinforcing metal and both increase the electrical conductivity, which is objectionable if the structure is likely to be subjected to the action of electric currents, in which case electrolysis might be set up, with eventually serious results.

We trust that the information we have volunteered will be of interest to you and possibly of interest to your readers. In either case you are at liberty to make such use of it as you see fit. We shall appreciate having you consider at any time that a part of our efforts can be drawn upon in the best interests of any use of cement or concrete, and we shall be glad at any time to have you make use of any such service we can offer.

Chicago. WILLIAM M. KINNEY.

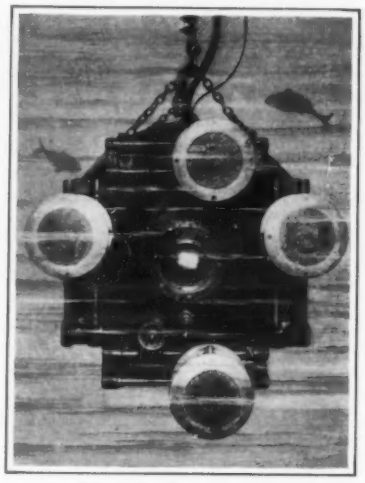
Lowering the spherical submarine.

In Quest of Sunken Treasure

Spherical Car for Deep Sea Salvage Work

By C. L. Edholm

[Interest in this deep-sea salvage device lies chiefly in the fact that it has actually been built. But what will it ever do? It is no small task to lower pontoons of size sufficient to raise even a small steamer. Then, assuming that the ship is not buried in mud, comes the difficulty of attaching them in such a way as not to tear the ship's plating off. Finally, even with pontoons on the surface, the greatest difficulty is experienced in raising a vessel with such even tension as to prevent the chains from snapping, one after another, and plunging the vessel to the bottom again. Only an experienced wrecker realizes the enormous weight and extreme frailty of an ocean steamer.—EDITOR.]



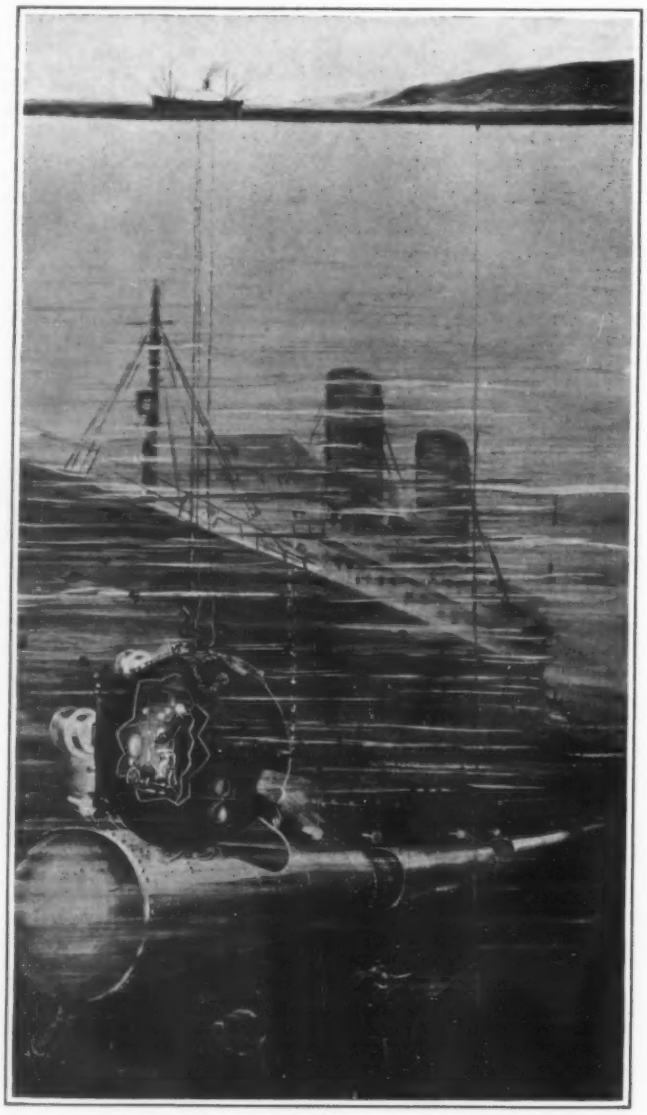
The four adjustable electro-magnets.

THE sea is full of gold, not only in chemical solution, but also in real coin, dollars, double eagles, pounds, Napoleons, doubloons, talents, shekels. It is all there, with vast quantities of bullion and other treasures untold, the tribute that the old pirate Neptune has exacted from man through the long centuries since the first mariner ventured forth in his rough log boat. We could better endure the annual levy were it not hoarded like miser's gold, never to be put into circulation again; and so we find men ever scheming to penetrate the treasure vaults of the deep and recover some of the rich plunder. The latest scheme calls for the use of an armored car—armored against the enormous hydraulic pressure with which old Neptune tries to crush those who would venture deep into his domain. In order to make it a particularly hard nut to crack the car is made in the form of a sphere. This car has actually been built, as our photographs show. Needless to say, the picture of the car at work is drawn from pure imagination and represents the inventor's dream of what he expects to do at depths below the reach of the common diver.

The device, it will be seen, has some of the features of a diving bell and some of a submarine boat. Like the diving bell, it is connected by chains and cables to a tender ship, from which it receives electric current to operate a powerful motor. The sphere is a metal shell an inch and a quarter in thickness, is equipped with two propellers on universal joints, and these enable it to cover a wide radius at the end of its cable, so that when the device is lowered at the approximate location of a wreck, it can search for it if not immediately found. It carries a searchlight, which may be directed over the bottom from the submarine, and by a telephone system the tender is instructed to change the position of the sphere as required. Two men are carried in the sphere to operate its motors and to communicate with the vessel above.

Here is the plan of procedure as mapped out by the inventor, William D. Sisson, of Los Angeles:

When the wreck is located, the submarine car ascends to return with a pontoon of corrugated steel, which is equipped with an electrically operated pump. The pontoon is sent down filled with water, and when attached to the side of the wreck, the water is pumped out by current from the tender. The pontoon also carries a number of cables, and at the end of each is a float and a pontoon hook. If the wreck is of iron or steel construction the method of attaching the pontoon is as follows: The submarine is furnished with four electro-magnets which exert a pull of many tons when energized. The car approaches the hulk, an operator throws on the current, and the sphere is firmly clamped to the wreck. Then an electrically driven drill which is placed between the four magnets bores a hole in the side of the hull and the sphere is shifted a few inches without releasing the hold of the magnets. Meanwhile the pontoon has been set in position below the sphere, with its pontoon hooks supported by floats within a short distance. When the hole has been drilled to receive it, a hook is seized by a magnetized arm and inserted in the side of the vessel, a spring catch prevents it from slipping out, and the sphere is then shifted a short distance and another hole drilled in the wreck. This operation is repeated until a sufficient number of hooks are inserted, after which the submarine ascends once more to bring down another pontoon. The number and size of pontoons used varies according to the size of the wreck, of course. When the required number have been attached to the wreck, the electric pumps in the pontoons are set in operation from the power plant in the tender ship and the water is gradually forced out, until as they become buoyant, they exert a pull on the cables attached to the sunken vessel. The men in the submarine are able to observe this operation and control it by ordering pumps on one side or another to be operated, so that the hulk can be brought up on an even keel. By continued pumping, the pontoons finally succeed in floating the wreck to the surface, after which the tender can tow it to the most convenient port or drydock for salvage.



Attaching air cylinders to a wreck.

A Children's Museum

TO the Brooklyn Institute of Arts and Sciences, Brooklyn, N. Y., is due the credit for the establishment of what is said to be the pioneer "Children's Museum" in the United States. Boston has been quick to recognize the moral and educational value of the newest juvenile institution, and has just founded its own museum for little folk.

In the Brooklyn Children's Museum, in Bedford Park, that city, it is the constant aim of the members of the staff to see that its little visitors find what they need and want. A docent has been appointed, in addition to the regular assistants, so no child need wander aimlessly about the rooms. At all times the permanent collections of specimens, charts, and models may be viewed, and schools are invited to use the museum as often as may be desired, either by the visit to the building of classes or by having small collections sent to the schoolroom or assembly hall.

At certain times there are special items of interest. Just now Miss Gallup, the curator, is planning a bird calendar, which will be, as its name suggests, a memorandum for the year of the birds of the region about Brooklyn and Long Island. Under each month there will be listed the birds seen in Prospect Park, the popular playground of the "City of Churches," during that period. In this way the "feathered folk" that abide permanently in the neighborhood, as well as those migrating in the spring and fall, can be studied. Models for this collection are now in preparation.

An interesting addition to the museum's department of geography is also under consideration. It will comprise five groups showing primitive peoples in the zone belts. It is doubtful if a better way than this could be devised to illustrate in a pictorial manner the life of man in relation to his environment.

The models will be accurate to the last detail, and will be rendered specially suggestive to the impressionable child-mind. The first grouping already is completed and has been passed upon by Mr. Miller, who was with Col. Roosevelt on his last exploring expedition in South America, and also by Mr. Hornaday, director of the New York Zoological Society. This represents life in the neighborhood of the Amazon River, centering about a Carib Indian. These, together with the history models prepared by Miss Agnes E. Bowen, will, when completed, form a valuable and attractive educational exhibit that should be utilized freely by teachers.

Typhoid in the British Army.—The latest illustration of the beneficent effects of anti-typhoid inoculation is the statement made to the House of Commons on February 8th by the British Under-Secretary of State for War that only 421 cases of typhoid had occurred in the British forces during the present campaign, and of these 305 cases were in men who had not been inoculated within two years. Among the men who had been inoculated there was only one death, and this was of a man who had received only one inoculation instead of the regular two. *Nature* compares this record with that of the Boer War, when the British had 58,000 cases of typhoid, of which 8,000 terminated fatally.

The eye end of the equatorial coudé at the Paris Observatory, arranged for making a photograph.

The Paris Observatory and Its Work

The History of a Famous Institution

By Prof. George A. Hill, U. S. Naval Observatory

IN the southern portion of the city of Paris is the National Astronomical Observatory of France. The extensive grounds in which the buildings used in astronomical research are located is bounded on the south by the Boulevard Arago, named after one of the brilliant directors of the Observatory who filled that office from 1811 to 1853.

The Observatory faces toward the north, and entrance is by way of the handsome Avenue de l'Observatoire, that leads directly to the garden and palace of the Luxembourg. At the approach from that side is a high iron fence, with a watchman's lodge on the left. The gate is always closed, and admission can be obtained only if the visitor is known to the watchman.

Passing the gate, the first object to catch the eye is a life-size monument to the memory of Urbain Jean Joseph Le Verrier, one of the illustrious directors of the institution, who filled that office from 1854 to 1870 and from 1873 to 1877.

Many are familiar with the mathematical knowledge possessed by Le Verrier, for it was his profound study, carried on at the same time by Adams of England, that designated the place in the heavens toward which the astronomer should point his telescope to discover Neptune, the outmost planet of the solar system.

The main building, which was built 1667-1672, is in the side of a hill, and antedates the Greenwich Observatory by a few years, the first stone for which was laid in the late summer of 1675. It also antedates the Royal Observatory at Berlin.

Entering the building, the visitor passes through a long hallway and then ascends a stairway to the floor above, where are the offices of the director, astronomers, assistants, computers, and the museum. This floor is at the height of the terrace of the grounds, and on the south are the beautiful gardens of the Observatory and a number of isolated buildings containing various astronomical instruments.

Attached to the institution, now over two hundred and forty years old, is a museum of great astronomical and nautical interest. In it will be found a sextant made by Langlois in 1750. In astronomical instruments the mural circle made by Bird in 1774 would immediately attract attention. It was used at the observatory of the military school at Paris from 1778 to 1785. The early history of the instrument dates back to our first knowledge of the positions of the stars in the heavens. With this mural circle, Lalande, from 1789 to 1799, made 50,000 star observations. It was used by Burckhardt from 1803 to 1825, and by Damoiseau from 1825 to 1834. It has been truly said this mural circle was the astronomical instrument that first gave a detailed representation of the stellar heavens.

It would consume too much space to describe all the instruments and articles of historical interest to be seen in the museum, but mention may be made of the first Fresnal lighthouse lens, made by Soleil. On the walls are paintings of the portraits of famous astronomers of all ages, photographs of interesting stellar and planetary objects, and large celestial globes of the sixteenth century stand on the floor.

At the extreme western end of the building are the dwelling rooms of the director of the Observatory, Dr. Bailland. At the eastern end are the meridian observing rooms. The upper stories are used for computing and storerooms, while above these are a number of domes which contain equatorial telescopes.

Previous to 1863 observations of the meridian transit of the sun, moon, planets, and stars had been made with two instruments, namely, a transit and a mural circle, one for observing the right ascension of the object, and the other its declination. In that year, from specifications prepared by Le Verrier, M. Eichens constructed the large transit circle that is shown in the photograph, which is mounted in an east wing of the Observatory.

The building stone that was used in the past in the construction of the many handsome edifices in Paris was taken from practically beneath the city or its immediate vicinity. These excavations produced the huge subterranean chambers that have been called the catacombs.

Under the Paris Observatory is a pronounced instance, and the standard astronomical clock of that institution is located in a cellar, eighty-four feet beneath the surface of the ground. The temperature of the air at that depth is practically constant for the whole year, and advantage was taken of that condition to install the standard clock here. The location is nearly ideal, for the writer from personal use of the clock, in a series of astronomical observations, has found its daily rate to be as small as from two to three hundredths of a second of time.

The pier upon which the large transit circle is placed is of very solid construction. The foundation is a monolith, over six feet thick and sixteen feet high, extends the entire length of the observing room north and south, and terminates in the upper terrace of the grounds. This foundation was constructed two centuries ago, of an excellent material, and the whole mass forms a solid wall upon which are placed two upright piers to support the transit circle. These piers are also huge masses of stone.

The body of the telescope is of cast iron. Four of the sides of a cube form the points of attachment for the tube and axis. The length of the two truncated cones are unequal, that carrying the object glass being the longer.

As is shown in the illustration, the piers which support the instrument are unequal in height. The east pier, the one on the right, is nearly a meter higher than the other. The object glass, made by M. Secretan, is 9.3 inches in aperture, and the focal length of the instrument is 12 feet 8 inches.

There are two divided circles on the instrument, one for measuring the angular distance of a celestial body from the zenith, and the other for approximate setting purposes. Both of the circles are fastened to the eastern side of the cube of the transit circle. The outer one, which is hidden by the high pier, is made of bronze one meter in diameter, and the silver band on its circumference is divided into five-minute spaces.

The inner circle, which shows in the illustration, is made of cast iron, and is 1.20 meters in diameter. On it the divisions are not as fine as those on the other

(Concluded on page 255.)

The Heavens in March

Measuring the Distances of the Nearer Stars

By Henry Norris Russell, Ph.D.

THE enormous distances of the stars have long been a theme of general interest. Even the nearest of them are so far off that it is harder to get a real conception of the relation of their distances to those with which we ordinarily have to deal than it is nowadays to measure the stellar distances themselves.

It is easy enough to say glibly that the very nearest star is 25 millions of millions of miles away, but we may understand better what our words mean when we realize that, could some one be set to count these miles, one by one, at the rate of 200 per minute, it would take him 240,000 years, working night and day without a moment's rest, before the tremendous task was completed.

The distance from Earth to Sun—the "astronomer's yard-stick" as some one has called it—is relatively insignificant; our imaginary teller could count the miles composing it in a little less than eleven months, if he never stopped to rest.

Let us start now with this distance, and make a map on which it corresponds to one inch, or, rather, a model, since if we are to put the stars on it in their correct positions it must extend in all directions in space from its center, and not in a single plane. The Sun, on this model, will be represented by a ball 1/110 of an inch in diameter—a small grain of sand. The Earth, which is a hundred times smaller, would be hardly larger than a microbe. The stars, like the Sun, would be represented by grains of sand of various sizes; and the speck which represented the nearest one would be more than four miles from the particle which stood for the Sun.

Somewhere between fifty and a hundred stars would be found on our model within twenty miles of the Sun; all the rest of the millions which are known would be farther away. How much farther? This is one of the great questions whose answer is just beginning to come into sight. In describing these great distances it is convenient to use as our unit the distance which light travels in a year, called for brevity a "light-year," which corresponds almost exactly to one mile upon the scale of our imaginary model of the universe.

The nearest star is then between four and five light-years from the Sun. By direct methods we can measure distances up to about 100 light-years, and from a study of the motions of the stars we can estimate the average distances of groups which in some cases are 500 and even 1,000 light-years away. Some of the stars visible to the naked eye and very many of the telescopic stars must be beyond even that limit. We know, however, that space is not thus filled with stars forever, for, if it were, the number of faint stars visible in great telescopes would much exceed that which is observed. Ultimately, the stars must "thin out"; that is, at sufficiently great and increasing distances. They must be more and more sparsely scattered in space. How far would we have to travel before we found this to be the case?

A partial answer has been given by certain work of Hertzspring, and also by Shapley and the writer upon variable stars. In certain cases it is possible to estimate from the details of the variation of a star's light, how big and how bright the star actually is. These estimates cannot as yet be made very precise, but are probably fairly trustworthy. By comparing the brightness with which the star appears to us to shine with the calculated brightness which it would exhibit if at some standard distance, the actual distance of each of the variable stars under consideration can be estimated. Hertzspring's results deal with the "short-period" variables (of which the well-known star Delta Cephei is the type) and the writer's with the eclipsing variables, such as Algol. In both cases the calculated distances of most of the stars are enormous. Not a single one of the 157 variable stars is within 100 light-years of the Sun, and only five—including Algol, Beta Aurigae, and Polaris—are within 200 light-years.

Almost half of the eclipsing variables and three quarters of those of the short period, or "Cepheid" type, are more than 2,000 light-years distant, and a considerable number are more than twice as remote.

In this way, which enables us to study stars which, though they appear very faint to us, are really of great luminosity, we can sound the depths of space farther than by any other method yet known. Examination of the results reveals the striking fact that all the remoter stars in the list are situated in the heavens close to the Milky Way. There are some stars among those studied which (as we see them) lie in parts of the sky remote from the Galaxy; but these are all relatively near us; that is, they all belong to the nearer half of the whole group.

This is one more confirmation of the old belief that the region of space within which the stars are scattered extends much farther in the direction of the Milky Way than at right angles to it; but the present method of attack has the advantage that it makes possible a rough estimate of the actual size, or, at least, of the actual thickness of this vast cluster of stars.

If we draw a plane through the Sun extending in all directions toward the central line of the Milky Way and calculate the distances of our variable stars above or below it, we will find that the average for the whole 157 is but 360 light-years—a small fraction of their average distance measured parallel to the plane, which is 3,100 light-years.

Seventy-eight per cent of these stars lie within 500 light-years from this plane, and only 8 per cent of them are more than 1,000 light-years away from it on either side, the greatest distances being about 1,600 light-years.

There is no known reason why stars at a greater distance in this direction should not be as easy to see as those equally remote in the direction of the Milky Way, and the fact that we do not see them indicates that they are not there; at least in any considerable numbers. We may, therefore, say: The large majority of the stars accessible to this powerful method of investigation lie in a layer about 1,000 light-years thick, which extends in all directions toward the Milky Way for several thousand light-years.

Outside this layer the stars thin out very rapidly on each side, while along the layer toward the Milky Way there is as yet no evidence that our soundings have struck bottom. The Sun is nearly, but not quite, in the middle of the layer, the evidence showing that it is about 100 light-years to the northward of the central plane.

All this is based on the assumption that the starlight traverses even these enormous distances without perceptible loss. If we assume, as some astronomers have done, with considerable reason, that there is some loss of light by absorption in space, we will get smaller dimensions for the vast star-cloud of which our Sun is a member; but no reasonable assumptions will make it less than 600 light-years in thickness (not counting the outliers on each side) and 6,000 light-years in diameter. The extension of similar studies to fainter stars may make it possible before long to set some limits to the extent of this vast swarm of stars in the direction of the Milky Way. In any case, we know that there are other star-clouds outside it, for in the southern heavens are two patches of light far from the Milky Way, but looking like portions of it, which are known as the Magellanic clouds, since they were first noticed by the great navigator. These are full of variable stars, and Hertzspring, applying his method to the smaller of the two clouds, computes for it the enormous distance of 30,000 light-years. At such a distance the Sun would be invisible in the greatest telescopes ever constructed, though it might perhaps be photographed with a very long exposure.

At 11 o'clock: Mar. 8.
At 10½ o'clock: Mar. 16.
At 10 o'clock: Mar. 23.

At 9 o'clock: Apr. 7.
At 8½ o'clock: Apr. 14.
At 8 o'clock: Apr. 22.

At 9½ o'clock: March 30.

NIGHT SKY: MARCH AND APRIL

The Heavens.

The finest region of the evening sky is the southwest, where we find Orion flanked by Taurus on the right and Canis Major on the left, with Gemini and Canis Minor above him. The southern sky is relatively dull, the most conspicuous constellation being Leo, high toward the zenith. The huge length of Hydra is now fully displayed. The monster's head, marked by a rather conspicuous group of stars of the third and fourth magnitudes, is about half-way between Regulus and Procyon. The isolated bright star Alphard marks its heart, and the sweeping curve of its tail extends far eastward and southward to the horizon under Virgo. In the southeast we find the small but prominent quadrilateral of Corvus, whose two uppermost stars point straight toward the brighter Spica in Virgo. Arcturus is resplendent in the east, with Corona and Hercules below and farther north. Draco and Ursa Minor are on the right of the pole, Cepheus below it, Cassiopeia below on the left, and the Great Bear high above it, extending to the zenith. Perseus and Auriga in the northwest bring us back to our point of departure.

The Planets.

Mercury, Venus, Mars, and Jupiter are all morning stars throughout March. Mercury is best visible in the latter half of the month, during which interval he rises between 5 and 5:15 A. M. He is in Aquarius, not very far from Jupiter, but rises the first of the two. On the 29th the two planets are in conjunction and little more than a degree apart, while Mars is but 3 degrees above them. Jupiter is the brightest of the three, appearing about equal to Sirius. Mercury resembles Arcturus in brightness, while Mars is hardly superior to the brightest stars of the Dipper.

Venus, too, is a morning star, rising between 4 and 4:30 A. M., and far exceeding the other three in brilliancy. Mars can only be well seen during the latter part of the month, and this is even more true of Jupiter, who is barely past conjunction. On the 23rd these two planets are only one fifth of a degree apart, but, unfortunately, both are too low in the sky to be easily seen before the day breaks.

Saturn is in quite a different part of the sky, being in quadrature west of the Sun on the 17th, and best observable in the evening.

Uranus is a morning star, and may be easily picked up on the 19th, when he is 1 degree 10 minutes south of Venus.

Neptune is in the borders of Gemini and Cancer, visible until about 3 A. M.

The Moon is full at 2 P. M. on the 1st, in her first quarter at 7 A. M. on the 8th, new at 3 P. M. on the 15th, in her last quarter at 6 P. M. on the 23rd, and full again at 1 A. M. on the 31st. There are thus two full moons again this month, though there was none in February. The moon is nearest us on the 5th, and remotest on the 21st. She is in conjunction with Venus on the 11th, Uranus on the 12th, Mercury on the 13th, Mars and Jupiter on the 14th, Saturn on the 23rd, and Neptune on the 25th.

At 11:43 A. M. on the 21st the Sun crosses the celestial equator, returning to the northern hemisphere and "spring begins."

Mellish's Comet.

A small bright comet was discovered by Mr. John E. Mellish of Cottage Grove, Wisconsin, on the morning

(Concluded on page 255.)

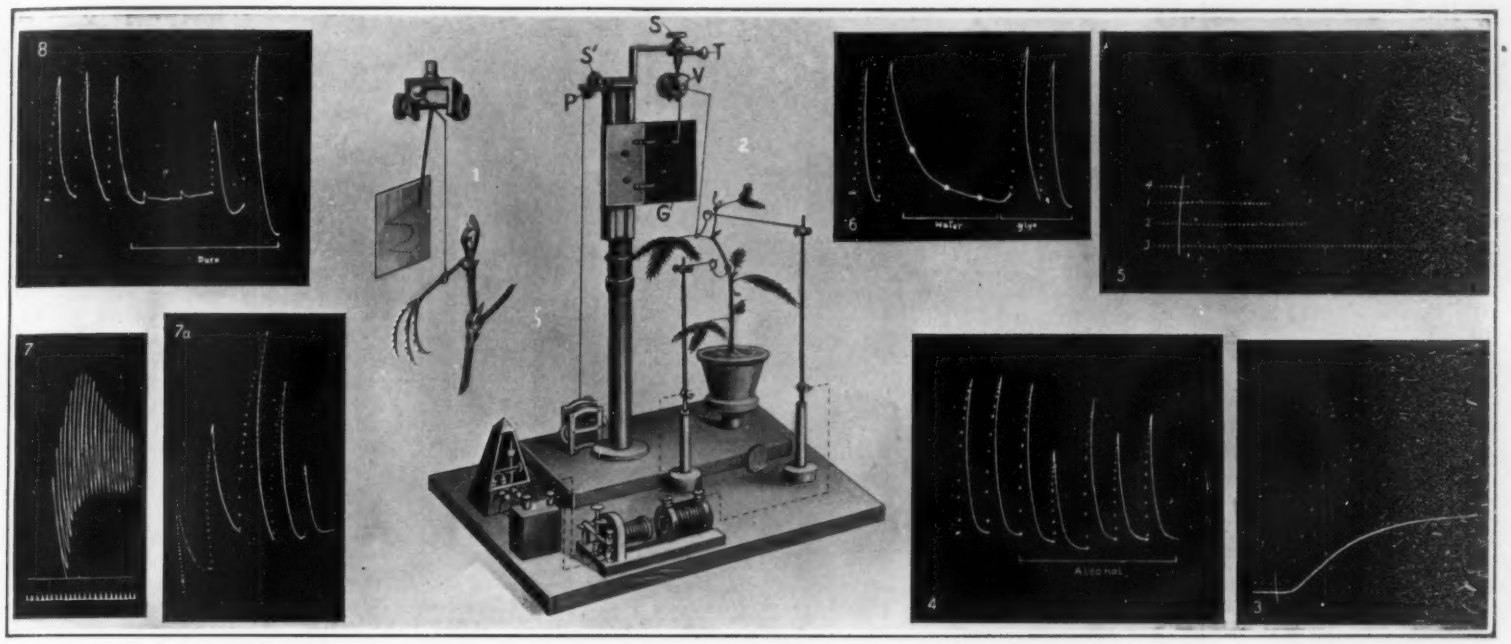


Fig. 1.—The essentials of a response recorder. **Fig. 2.—General view of the resonant recorder.** The thread from the clock passes over the pulley *P*, so as to lower the smoked recording plate *G*. The writing point is adjusted for distance by the screw *s'*; vertical adjustment is effected by the screw *S*; in order to adjust the plane of the recorder's movement parallel to the writing surface, a tangent screw *T* is provided. The picture shows also the electrical connections by means of which an excitatory shock of definite duration may be given to the plant by metronome which completes electrical circuit. Fig. 3.—The dotted line is correct, the continuous line incorrect, thus showing the advantage of intermittent over continuous contact in obtaining records. Fig. 4.—The effect of alcohol vapor; note the alternating character of the response after application. Fig. 5.—Effect of cold in inducing retardation and arrest of transmission: (1) normal record; (2) retardation due to slight cooling; (3) arrest of conduction brought about by intense cold; (4) record of direct stimulation. Fig. 6.—Effect of excessive absorption of water; note the prolongation of the period of recovery and the ineffectiveness of stimuli applied at moments marked with thick dots and subsequent restoration of excitability by application of glycerin. Fig. 7 and 7a.—Preliminary staircase followed by fatigue in the response of frog's muscle (Brodie) and staircase response followed by fatigue in Mimosa (Bose). Fig. 8.—Effect of sudden darkness on the excitability of Mimosa; first three responses normal; four succeeding responses due to the effect of darkness; the line below indicates the period of darkness.

Plant Autographs and What They Mean

An Investigation Which Proved That Plants Have the Same Sensations as Animals

WHAT is it that distinguishes a plant from an animal? It is response to excitation, pleasant or unpleasant, to all intents. Strike a dog and he will wince with pain. Strike a tree or a bush, and it remains imperturbable. To be sure there are "sensitive" plants, like Mimosa, which close their leaves when touched, but no biologist would dream of pain in that connection. In other words, a plant seems to differ from an animal in a total lack of psychological response to the outer world. Even the automatic action of Mimosa has been attributed to hydromechanical and not to excitatory causes.

These well-established conceptions of plant life have been completely upset by the remarkable experiments conducted for many years by Dr. Jagadis Chunder Bose, a professor of Presidency College, Calcutta. After lecturing in England before the Royal Institution and other scientific bodies, Prof. Bose was sent to the United States by the British government in order to acquaint American scientists with his work. He has lectured before our leading universities and scientific societies, with a success that is rare.

Prof. Bose has succeeded in demonstrating by actual experiment that there is no essential difference between an animal or plant in responding to external stimulus, that the mechanism of response is similar in both, and that there is no barrier whatever between the animal and the plant, such as we have imagined. Like an animal, a plant can be drugged, poisoned, exalted, depressed, and fatigued, and like an animal it proves to have nerves which transmit excitation with a measurable velocity.

The Ingenious Instruments With Which Plants Write.

This astonishing discovery was made with instruments of unprecedented delicacy, instruments which Dr. Bose invented for the very purpose of analyzing plant sensations. In Fig. 1 the principle of the instrument is set forth in a broad way. A graphic record of plant movements, however minute, must be made. Hence some form of writing lever must be used, which as shown, is connected by means of a very delicate thread with a leaflet. The writer is a thin vertical wire attached to a counterpoised horizontal lever, supported in frictionless jeweled bearings. As the leaf falls under excitation a glass plate is lowered at a uniform rate by clockwork, and upon the smoked surface of this plate the writer will trace a curve, which will be not only a record of the responsive movement, but a record of the time relations involved.

Such an apparatus might have been employed long ago had it not been for its obvious inaccuracy. It must be clear to every one that the friction of the writer upon the smoked glass completely vitiates the accuracy of the record. To make the system trustworthy

(Concluded on page 256.)

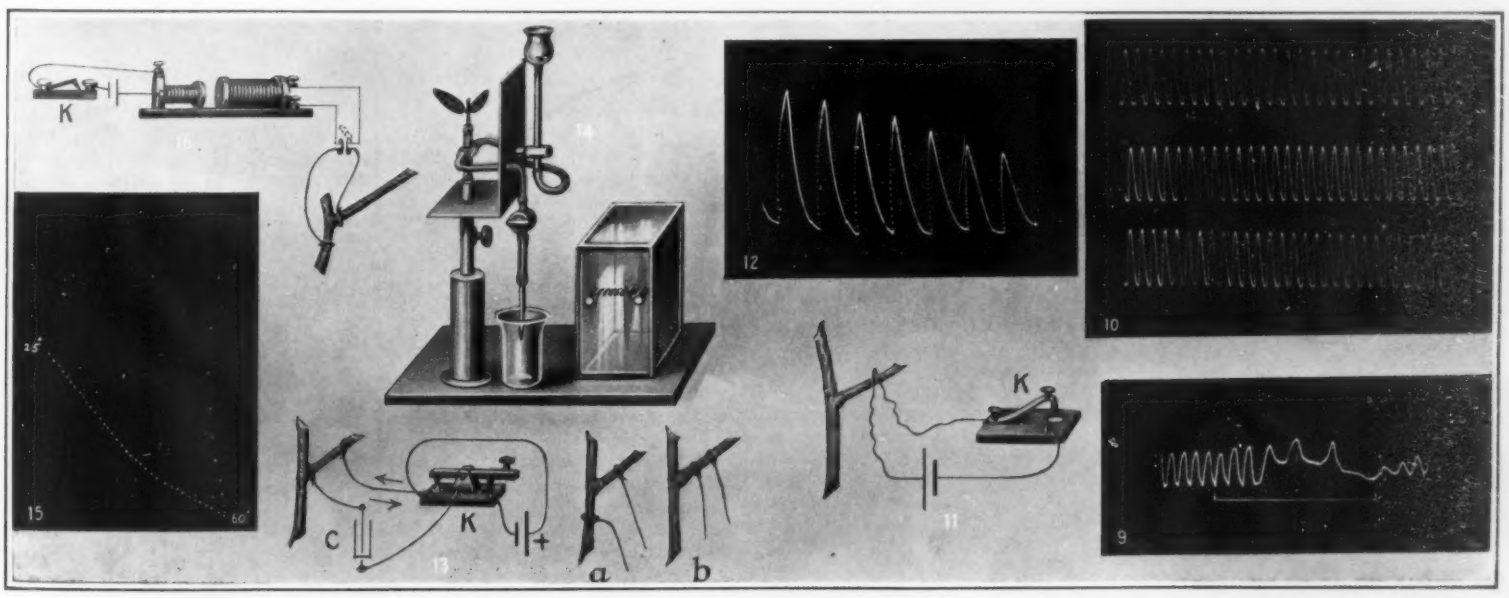


Fig. 9.—Strong carbonic acid gas, inducing arrest. The line below indicates the duration of the application. Slow revival of pulsation on substitution of fresh air. Fig. 10.—Continuous record of pulsation of Desmodium leaflet for four hours; the series to be read from below to above. Fig. 11.—Electrothermic stimulator for uniform stimulation; metronome is employed in place of key *k*, for closing circuit for a definite length of time. Fig. 12.—Record showing growing fatigue of Mimosa. Fig. 13.—Direct stimulation by condenser discharge; *c*, condenser; *k*, key; *a*, intra-electrodal, and *b*, indirect extra-electrodal mode of stimulation. Fig. 14.—How detached leaflet of telegraph plant is mounted to study pulsations. The petiole is mounted in the shorter open end of a narrow U-tube filled with water. The longer end of the U-tube consists of India rubber tubing. By raising or lowering this longer limb the hydrostatic pressure can be varied. The stop cock allows the water to run out when chemical solutions are to take the place of water. A light cover with mica windows can be made to inclose the specimen. By means of an electric current sent through a spiral of German silver the inside of the chamber can be heated to any desired degree. Fig. 15.—The death-curve of Mimosa. Successive dots in the down or expansive part of curve represent rise of temperature of one deg. Cent. Spasmodic contraction causing inversion of curve takes place at 60 deg. Cent. with all plants. Fig. 16.—Arrangement for applying single make or break; *k*, key in the primary circuit. The secondary circuit may be short-circuited by the second key.

Hearing Liberty Bell Across the Continent

HISTORIC old Liberty Bell, which tried so valiantly to proclaim, far and wide, the joyful news of our declaration of independence, recently tried its voice again, and this time succeeded in making itself heard a thousand times farther. Fitted under the bell was a telephone transmitter connected with the transcontinental telephone line, and when it was tapped with the mallet the ring of the cracked old bell was heard in San Francisco. A record of this historic event was made by a phonograph so that the tones of the veteran of Revolutionary times might ring down through the ages.

Copyright by Underwood & Underwood.

Liberty Bell speaking across the continent.

Iron Sides for Roads

EVER since the Williamsburg bridge was constructed a great deal of trouble has periodically arisen over the shortness of the life of the pavements used in the road bed. No matter what sort of paving blocks were put down, the heavy nature of the traffic and the incessancy with which it flows soon resulted in deep, troublesome ruts along either side of the road. Lately this depreciation has gone forward at a considerably faster rate owing to the increased weight of trucks which pass over it.

After experimenting with every known type of pavement, the bridge engineers, as a last resort, hit upon the idea of lining the edges of the road, where the ruts occurred, with iron blocks. The blocks are cast hollow with open ends and sides, perforated tops and closed bottoms. They are afterward filled with concrete.

To break up the old pavements a pneumatic "rivet buster" was used, that is, a pneumatic hammer with chisel point employed in breaking and knocking out the rivets of worn out structural work. An engineer of the bridge paving department extricated a seemingly worthless machine of this type from the junk heap, had it repaired and put it to work on the old and rutted paving. The paving blocks were so firmly cemented that a man with a pick could scarcely make an impression on them. Under the blows of the rejuvenated "rivet buster," however, the paving blocks are readily broken apart.

Breaking up old pavement with a pneumatic "rivet buster.". The insert shows iron blocks for lining the road.

Safety match holder with a roll of striking tape.

Planting an electrically controlled mine.

Safety Match Holder and Box

THE pocket match box has suffered a serious decline in recent years, mainly because safety matches have displaced the common friction matches in cigar stores, and they cannot be ignited on the ordinary striking surface. And so in place of the neat little case of gold or silver men have come to carry unsightly wooden match boxes or packets of paper matches. For a similar reason the match holder has given place to a stand in which a common safety match box is placed. Recently Mr. J. E. Neahr of New York city has devised a holder in which there is a roll of paper surfaced with the chemical coating on which the safety matches may be ignited. This striking tape runs around the base of the match container. Whenever the surface becomes worn a catch may be lifted and a new surface pulled from the roll. This will last for many months. A pocket safety match box has also been designed, at one end of which is a roll of striking tape. Normally this is covered to protect it from wear and dirt in the pocket.

Mine-planting

THE accompanying photograph was taken aboard one of our own mine planters, and shows a type of mine with its automatic anchor. The anchor weighs 1,500 pounds, and the mine is loaded with a hundred pounds of trotol. The mine is of the controlled type, which can be fired only by an electric current supplied from a station on shore. The photograph shows it hanging over the side of the mine planter, ready to be dropped into the water by tripping the hooks which support it, when the vessel reaches the desired location.

The Nipa Palm of the Philippines

AMONG the physical assets of the Philippine Islands is the Nipa palm, the sap of which has the important distinction of being the cheapest raw material known in the world for the making of sugar and alcohol. After extraction from the flower stalk this sap is known as "tuba" and contains, when fresh, about 15 per cent of sugar. Investigations made by the Philippine Bureau of Science bear the definite conclusions that nipa sugar is equal to cane sugar and can be extracted cheaper, as no crushing machinery is necessary; also, that a hectare (2.47 acres) of nipa will produce 22,942 pounds of sugar, which, valued in United States currency at 8 cents per kilo (2.2 pounds) would yield an annual income of more than $800.

The yield of alcohol varies, depending on the grade of the primary product. It has been found that a hectare of nipa (about 2,000 plants) will average 21,500 gallons of sap per year; and that from four to 7.5 gallons of sap are required to produce 0.25 gallon of alcohol. Nipa alcohol was awarded the first prize for purity at the Paris Exposition.

The use of alcohol of 186 proof, mixed with 10 per cent gasoline, has been shown to be of equal effectiveness with pure gasoline in a year's continuous trial in six automobiles in Manila. That city imports about $200,000 worth of gasoline each year, which apparently could be supplanted by alcohol. Up to the present time no forest charges have been assessed on nipa products by the Government of the Philippine Islands, although such assessment is levied by the local governments of neighboring European colonies in the East Indies.

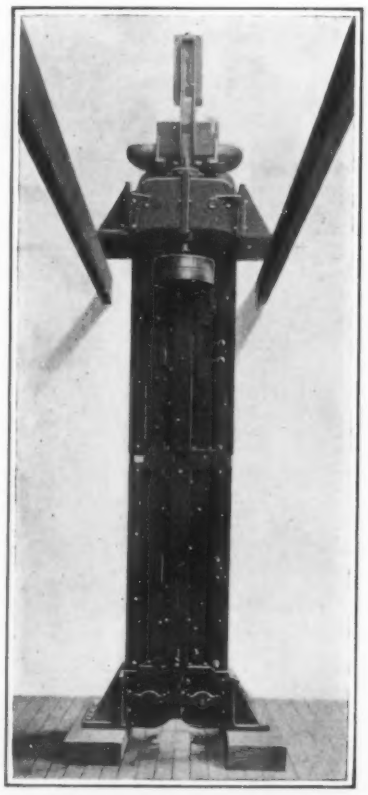
Award by the Franklin Institute

MR. GEORGE P. VANIER, chief chemist of the Pennsylvania Steel Company of Steelton, Pa., has been awarded a certificate of merit by the Franklin Institute, Philadelphia, Pa., for his potash bulb. This bulb has been particularly designed for use in the determination of the total carbon in iron or steel. The bulb is of large capacity, and, by the provision of a glass spiral in which the gases of combustion of the sample under test and the potash solution circulate together, a high rate of absorption of carbonic acid is obtained. With the bulb is combined a drying tube. Mr. Vanier has also designed zinc tubes and sulphuric acid bulbs for use in connection with the Vanier combustion train for the determination of carbon in steel by direct combustion method with the electric furnace. Both of these pieces of apparatus are great time savers in commercial laboratories.

Continuous Rod Machine

PICTURED herewith is a machine for making continuous rods of brass and the like. Molten metal is poured in at the top and brass or other rods of ⅞ inch or more in diameter will run out at the bottom as long as the metal supply keeps up and electric current is furnished for the operation of the mechanism. At the top of the machine is a graphite crucible into which the metal is poured, and through which it finds its way by gravity into a guiding tube and eventually into the molding bore of the machine. By the junction of two sections of molding blocks which form two endless chains, respectively, a two-part mold is effected. With the metal being fed into the receiver at the top and the chain molds being continuously moved, the liquid metal molds, solidifies and delivers itself automatically in the shape of an endless rod.

The operation is strictly mechanical and automatic, and it is the claim of the inventor, a man from Newark, N. J., that with the aid of the machine ⅞ inch rod in any length should cost less to produce than wire bar. The rod from the machine can be produced without any previous working and all rolling operations are done away with. The machine is driven by a 6 horse-power motor.



Machine for casting continuous lengths of rod.

The Paris Observatory and Its Work

(*Concluded from page 251.*)

circle, and it is used to point the telescope to the approximate position of the object to be observed.

The divisions of degrees and minutes on the outer circle are read by six microscopes, which give the seconds and tenths to complete the distance the object is from the zenith. The microscopes are mounted on the exterior face of the east pier and are secured on lugs attached to cast iron standards bolted to the pier.

When the instrument was first mounted the field of the eye-piece was illuminated by means of a gas jet, opposite the axis of rotation, and on top of the west pier. The axis of the instrument is perforated, and a movable diaphragm therein regulates the intensity of the light.

With this instrument the Paris Observatory carried on its extensive series of observations for the determination of the position of the sun, moon, planets, and stars. When the instrument was first mounted its object glass was the largest that had ever been made for a transit circle, and it is to-day the largest in use. However, astronomers have found that when the most refined work is desired, with that class of instruments, one of less aperture and less focal length will yield better results. The astronomers of the Paris Observatory recognized that, and in 1878, through the liberality of M. Bischoffsheim, a new transit circle was provided, and upon much smaller dimensions.

The new instrument is mounted in an isolated building in the grounds of the Observatory, about 150 feet south and a little east of the large transit circle. Its object glass has an aperture of 7.5 inches and a focal length of 7 feet 7 inches. With this new meridian circle the Paris Observatory has continued its meridian circle work, the larger one being now used merely for the purpose of obtaining accurate time. This is distributed from the Observatory over the railroad telegraph lines in France, and also by wireless from the powerful station at the Eiffel Tower, for the benefit of the shipping at the sea ports of France and also ships at sea.

One of the unsolved problems in astronomy is the probability of changes taking place in the crater formations and mountains on the moon. In the early history of the science certain astronomers, from visual observations secured by means of a telescope, made drawings of all the prominent objects on the surface of the moon, but at best that process could not compete with a well-developed photograph of the lunar surface. In making a drawing the operator can sketch only so fast, and while he is engaged upon the drawing the reflected sunlight and the shadows caused by its absence are constantly changing on the object he is attempting to transfer to paper. With a relatively quick photographic plate a much more detailed reproduction of any selected region on the moon can be secured in a very short interval.

An instrument designed with that purpose has been in operation for a number of years at the Paris Observatory. It is called an equatorial *coudé*, and it was first planned by M. Loewy, another of the illustrious directors of that institution. The mechanical form of the instrument is not at all similar to that of the ordinary equatorial refracting telescope. Imagine the main tube fastened to two upright piers, the one to the north much higher than the one to the south. This main tube is constructed so that it will revolve on a bearing at the top of the shorter pier. It is fastened to the longer pier by a sleeve, so the main tube can revolve. The angle of elevation of the tube is the same as that of the latitude of the place.

Near the lower end of the main tube is another, clamped to it so as to form a right angle at the point of joining. On the opposite side is another tube, attached to the main tube, and its purpose is to act as a counterpoise for the whole instrument. At the extreme end, and at the side of the second tube mentioned, is placed the object glass. A 45-degree mirror is fastened in the end of the tube, and another in the cube formed by the junction of the two tubes. A ray of light from a celestial object enters through the object glass, strikes the mirror at that point, is deflected down the tube until it reaches the mirror in the central tube, when it is again deflected up the main tube to either the eye-piece or the photographic plate.

In this form of instrument the astronomer remains seated at the eye end all the time he is observing or photographing, as the diurnal motion given the instrument by clockwork, to follow a celestial object, is around the eye end as an axis. The eye end of this instrument is shown in one of the illustrations.

The equatorial *coudé* has the following dimensions: The length of the tube containing the object glass is 5 meters. The length of the tube opposite to that of the one containing the object glass is 4 meters. The length of the tube to which the eye-piece or plate holder is fastened is 12 meters. The diameters of the tubes vary from 0.6 to 1 meter. The aperture of the object glass is 0.6 of a meter, and its focal length is 18 meters. The diameter of the exterior mirror is 0.86 meter, and of the interior one 0.73 meter.

In designing this instrument it was the intention of the illustrious astronomer to have made a telescope that would exactly reproduce, without enlargement, images of heavenly bodies. The construction of the telescope was commenced in 1889, and it was finished in April, 1890. The first observation was made with it in 1891.

With this equatorial *coudé* MM. Loewy and Puiseux have secured the splendid atlas of the moon that has been issued by the Paris Observatory, and in the vaults of that institution are more than two thousand photographs of the lunar surface. After these photographs were obtained MM. Loewy and Puiseux made a careful study of the hundreds of lunar formations thus obtained, and their writings upon that subject fill many pages of the publications of the French Academy of Sciences. The crowning work of all was the Atlas of the Moon mentioned. In this will be found enlarged reproductions of all the mountains, craters, dead seas, and plains that can be seen on the moon. The lunar enlargement varies from a diameter of 2 to 2.5 meters. The original negatives were 0.18 of a meter in diameter. The atlas is without doubt the finest reproduction of the visible portion of the lunar surface that exists, and the student of lunar formations will find in these enlargements a study of the highest interest.

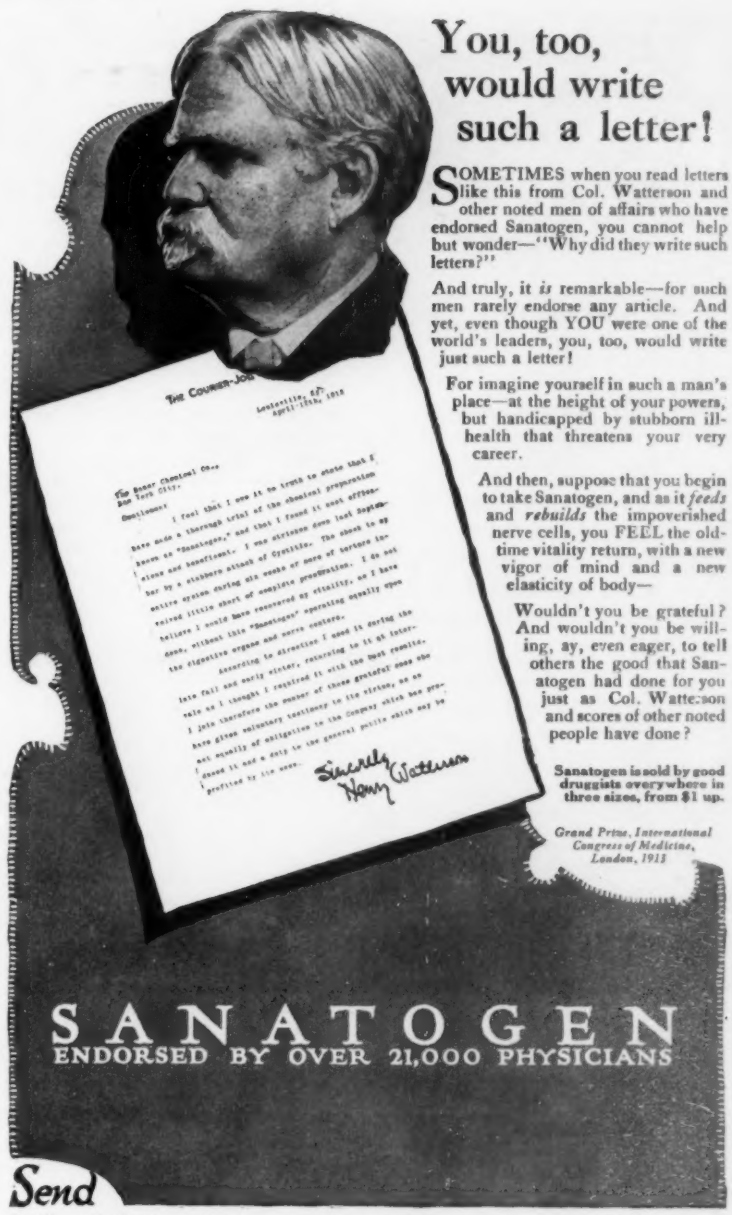
In the future, astronomers who obtain photographs of the moon have the means, by placing their photographs alongside those secured with the equatorial *coudé* of the Paris Observatory, to carefully compare every portion of the lunar surface, and to detect any change that has taken place in any crater or mountain formation in the interval between the time the first and second photographs were taken.

As the actual position of the moon in the sky at any instant holds but a short while to any theory of its motion that has yet been developed, and its predicted position for the future is liable to uncertainty, so it is impossible to state definitely that any of its craters or mountains have changed or are changing until photographs of sufficient size are compared one with the other. It is from such a collection we may expect to verify supposed changes, by comparison, over long intervals of time.

The Heavens in March

(*Concluded from page 252.*)

of February 10th. It was then in Ophiuchus, in 17 hours right ascension and 3 degrees north declination, and was moving slowly southward. Preliminary elements compiled at the University of California indicate that the comet is still remote from the Earth and Sun and will not come to perihelion till next August; but the comet's situation is such that the computed elements are uncertain, and more observations will be necessary to permit of accurate prediction. For the present, however, the comet will continue to travel slowly southeastward, and grow brighter. Its predicted position on March


You, too, would write such a letter!
SOMETIMES when you read letters like this from Col. Watterson and other noted men of affairs who have endorsed Sanatogen, you cannot help but wonder—"Why did they write such letters?"
And truly, it *is* remarkable—for such men rarely endorse any article. And yet, even though YOU were one of the world's leaders, you, too, would write just such a letter!
For imagine yourself in such a man's place—at the height of your powers, but handicapped by stubborn ill-health that threatens your very career.
And then, suppose that you begin to take Sanatogen, and as it *feeds* and *rebuilds* the impoverished nerve cells, you FEEL the old-time vitality return, with a new vigor of mind and a new elasticity of body—
Wouldn't you be grateful? And wouldn't you be willing, ay, even eager, to tell others the good that Sanatogen had done for you just as Col. Watterson and scores of other noted people have done?
Sanatogen is sold by good druggists everywhere in three sizes, from $1 up.
Grand Prize, International Congress of Medicine, London, 1913
SANATOGEN
ENDORSED BY OVER 21,000 PHYSICIANS
Send
for Elbert Hubbard's new book—"Health in the Making." Written in his attractive manner and filled with his shrewd philosophy together with capital advice on Sanatogen, health and contentment. It is FREE. Tear this off as a reminder to address THE BAUER CHEMICAL CO., 28-G Irving Pl., New York.

We Want to Introduce You
to our complete line of Drafting Furniture Drawing Boards, Tables, Stools, Filing Cabinets (Uniform Sectional), Blue Printing Outfits of every kind
We design and make equipment for Contractors, Engineers and Draftsmen, meeting requirements in a practical way and building for permanent customers.
We sell special and regular equipment to Carnegie Institute, Universities and Vocational and Technical Schools. We furnish regularly many of the largest drafting rooms in the country.
Special Offer this Month
Our Special Offer
To acquaint you with our line and furnish you with one of the greatest conveniences at Home or Office, we will ship prepaid East of Mississippi and North of Mason and Dixon Line, Adjustable Drawing Table — Oak frame, Soft Pine top adjustable two ways. This size is 31x42. Other sizes up to 43x72.
LISTED REGULARLY AT $10
SPECIAL OFFER TILL MAY 15, $7.50
SEND MONEY ANY WAY YOU LIKE
American Drafting Furniture Co.
200 Railroad St. Rochester, N. Y.
"Monroe"
$10
Value for
$7.50
SIZE
31x42
Catalog FREE

Insure Your Shipments
with THE INSURANCE COMPANY OF NORTH AMERICA
If you import, export, ship coastwise or on inland waters; or by rail, express, parcel post or any class of mail, we have an attractive policy to offer that meets your specific requirements.
The protection is broad, the cost moderate, and you get the benefit of our 122 years experience. Even if you already have protection, it is good business judgment to let us submit quotations. It places you under no obligation whatever. A request will instantly bring you full particulars.
INSURANCE CO. OF NORTH AMERICA
233 Walnut Street, Philadelphia
Writers of insurance covering: fire, rent, tornado, automobile, motor boat, marine, tourist, parcel post, etc.
Insist on a policy in the North America! Founded 1792

Magical Apparatus
Grand Book Catalog. Over 700 engravings 25c. Parlor Tricks Catalog Free.
MARTINKA & CO., Manufacturers, 493 Sixth Avenue, New York
ICE MACHINES
Corliss Engines, Brewers' and Bottlers' Machinery.
The VILTER MFG. CO.
899 Clinton Street, Milwaukee, Wis.

Smith & Wesson Automatic

Doubly safe -

Safety first, last and all the time

Safe against intruders when the time comes. Safe always against accident and carelessness. Safe where there are curious children. Fires when you mean to, not before.

Quick loading, easy cleaning. Usual Smith & Wesson accuracy and strength.

Get your dealer to show you the special features of the Smith & Wesson Automatic.

Booklet on request

SMITH & WESSON
805 Stockbridge St., Springfield, Mass.

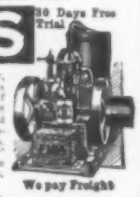
Every Smith & Wesson is the Best of its kind

6c for 10 Hours

With ordinary cheap kerosene develops 1 horse-power. Strongest, simplest engine made. Runs either way; reversible while running. Starts without cranking. Force-feed oiler, patent throttle giving Three Engines in One.

ELLIS ENGINES

30 Days Free Trial



are equipped with throttling governor, making them fast for shop work, farm work, electric lighting and dozens of other jobs. All sizes, from 1½ to 18 H.P. Vertical and horizontal, single and double cylinders. Sold on 30 days approval and guaranteed for 10 years. Write for free book "Engine Facts," giving complete information about free trial offer and special discount prices.

ELLIS ENGINE CO.
3809 E. Gd. Boulevard, Detroit, Mich.

We pay Freight

ELECTRIC HOME LIGHTING PLANTS
WITH STORAGE BATTERY
For Gas Engine Drive
ROTH BROS. & CO.
198 Loomis St., Chicago, Ill.

THE KEY TO THE LAND

By
FREDERICK F. ROCKWELL

Full of practical information, gained by actual experience, is this book which recounts the "making good" of a city man in the country.

Lack of experience was made up for by intelligence, study, and consultation with a neighboring experimental station.

The new methods in farming potatoes, corn, hay, etc., were criticized by the conservative farmers, but the results impressed them and they were glad to follow the city man's example.

While the healthful life and the pleasures of a dweller in the fields and woods are not overlooked, it is the economic feature which is the keynote of the book. The author has preferred to record in fictional form the actual happenings he recounts.

$1.00 net

HARPER & BROTHERS

1st is right ascension 17 hours 26 minutes 37 seconds, declination 1 degree 43 minutes north, and its motion 1 minute 15 seconds east and 5 minutes south every day. It should be easily visible in the morning sky for some time to come.

Princeton University Observatory.

Plant Autographs and What They Mean

(Concluded from page 253.)

Dr. Bose hit upon the ingenious principle of electro-magnetically tapping the smoked glass plate at regular time intervals, so that a dotted line is obtained instead of a continuous curve. Thus he was able to overcome at once the difficulty of friction.

But the invention of an instrument which would tap instead of trace records was not the easy task that might be supposed. Limitations of space forbid our discussing with the fulness they deserve the problems that confronted Dr. Bose. Eventually he devised the instrument—his "resonant recorder"—shown in Fig. 2. This instrument is so constructed that the recording point is given an electrical impulse exactly perpendicular to its recording movement; the intermittent closures of the electric circuit are properly timed, so that the writing index is not subjected to attraction in the course of its journey; the electro-magnet employed is cylindrical and therefore without laterality, so that the writing index cannot have a tendency to execute its to-and-fro vibrations in any other direction than that which is perpendicular to the plane of the terminal pole of the magnet. The electrical impulses are timed with the greatest regularity by means of a reed maintained in a state of persistent vibration by the usual electro-magnetic arrangement. This reed interrupter, called a coercer by Dr. Bose, is tuned to the natural frequency of vibration of the recording index, so that the intermittent magnetic pulls will exactly synchronize with the natural swings of the writing index.

The advantage of intermittent over continuous contact in obtaining records is well shown in Fig. 3, representing two successive experiments on the same leaf under identical stimulation. The lower record was taken with continuous contact and the upper with the same recorder, but in a state of vibration, giving intermittent contact. Stimulus was applied at the point marked by the vertical line.

How Plants are Stimulated.

Dr. Bose classifies stimuli into (1) mechanical (blows or pricks), (2) chemical (acids, alkalies, etc.), (3) thermal (hot wires, etc.), and (4) electrical (inductive shock, condenser discharge, constant current, etc.). Since chemical stimuli cannot be employed to obtain a series of uniform excitations for quantitative investigation, and since blows and pricks may cause mechanical jars which may affect the record, Dr. Bose prefers the thermal and electrical modes of stimulation, and, accordingly, employs the electro-thermic stimulator shown in Fig. 11, the condenser discharge apparatus shown in Fig. 13, and the induction shock apparatus shown in Fig. 16.

When a muscle is excited there is a brief interval between the incidence of the stimulus and the beginning of the responsive movement—a lag which is called the "latent period." After the lapse of the latent period the record-curves increase in amplitude to a maximum. The period required up to this point Dr. Bose calls the "apex time." With the resonant recorder Dr. Bose has found that different plants exhibit different characteristics of response. In summer Mimosa has a latent period of one tenth of a second; the maximum fall of the leaf was attained in three seconds (apex time), and the recovery was completed in fifteen minutes. The movement of recovery is about three hundred times slower than the excitatory fall, in this instance. Increase the stimulus and the extent of response increases. The stronger the stimulus and the higher the temperature the greater is the increase in the rate of movement. Fatigue decreases the rate. Winter produces a physiological depression which prolongs the latent period and reduces the amplitude.

All Plants are Sensitive.

Thus tested, all plants prove to be responsive. Hence, the old distinction between "sensitive" and "insensitive" plants is purely arbitrary and scientifically unjustified. Cabbages, peas, beans, and other kitchen vegetables are sensitive, although not so highly excitable as Mimosa. By means of electrical response, moreover, Dr. Bose has shown that every plant and every organ of a plant is sensitive and responds to stimulation by a definite electrical charge. An intensity of induction shock which is barely sufficient to induce sensation in man is quite enough to cause excitatory fall in a Mimosa of moderate sensitiveness. Indeed, Dr. Bose found that a highly excitable specimen can, under certain conditions, be ten times as sensitive as a man!

If, instead of permitting a plant to recover sufficiently after shock, it be stimulated again, a diminution in the height of response, indicative of fatigue, is noted. In a highly excitable specimen the phenomenon of growing fatigue can be easily recorded; in a sub-tonic specimen, an equally characteristic effect is obtained—a gradual enhancement or what is known in muscle investigation (with which it is exactly parallel) as a "staircase response" (Fig. 7). After attaining a maximum excitability under successive stimulation, there generally ensues a fatigue decline. This is to be attributed to the gradual bettering of the tonic condition under successive stimulations. In other words, the accession of stimulus gives rise to two kinds of effects—external and internal.

So sensitive are plants that even the passing of a cloud is not without influence, as Prof. Bose's records conclusively prove. Carry a highly excitable plant into a dark room and its excitability disappears for an hour. Prof. Bose noticed that Mimosa was depressed on rainy days. He was able to trace the cause to the absorption of water. Fig. 6 is a record which is instructive in this respect. A pair of uniform responses were first taken. A drop of water was then applied at the proper place (the pulvinus), when the leaf was recovering from the second stimulus. It will be noticed that the period of recovery became very much protracted in consequence of absorption of water. The plant was gorged, and like a gorged animal, its sensitivity had been affected. A drop of glycerin abstracted the water and restored excitability.

How Plants Suffocate and are Poisoned.

Gases have as marked an effect on plants as on animals. Carbon dioxide is popularly supposed to be good for plants. Prof. Bose shows that it is just as depressing and poisonous to a plant as to an animal. Ozone, as might be expected after this, is stimulating, so much so that a fatigued plant can be refreshed by its means. Alcohol vapor produces first exaltation and then depression, the plant responding in a very human way. Ether likewise depresses, but is not so narcotic as chloroform. Carbon disulphide resembles ether in its effect. Coal gas is moderately depressing. Ammonia abolishes excitability, for as long as two hours, if strong vapor is employed. Sulphureted hydrogen is not only depressing but extremely poisonous in its effect, and since it is found in large quantities in city atmospheres we can now well understand why it is impossible for some plants to thrive in towns at all. Nitrogen dioxide is fatal, and so is sulphur dioxide.

That plants die like animals we all know; but we do not know the exact moment when they die. For hours a dead plant seems alive. There is no twitch, no death spasm. Dr. Bose has succeeded not only in noting the precise moment when a plant gives up its life, but in recording its death spasm. The plant is heated very gradually so as to avoid all excitation. This is done by placing the plant in a water bath, the temperature of which is continuously raised by the application of a gas or spirit flame. At 60 deg. Cent. a spasmodic extraction takes place, clearly indicated in the record produced in Fig 15, which is in truth a death curve. All attempts to obtain response, after this

LEGAL NOTICES

PATENTS

If you have an invention which you wish to patent you can write fully and freely to Munn & Co. for advice in regard to the best way of obtaining protection. Please send sketches or a model of your invention and a description of the device, explaining its operation.

All communications are strictly confidential. Our vast practice, extending over a period of more than sixty years, enables us in many cases to advise in regard to patentability without any expense to the client. Our Hand Book on Patents is sent free on request. This explains our methods, terms, etc., in regard to PATENTS, TRADE MARKS, FOREIGN PATENTS, etc.

All patents secured through us are described without cost to the patentee in the SCIENTIFIC AMERICAN.

MUNN & COMPANY
361 BROADWAY, NEW YORK
Branch Office, 625 F Street, Washington, D. C.

Classified Advertisements

Advertising in this column is 75 cents a line. No less than four nor more than 12 lines accepted. Count seven words to the line. All orders must be accompanied by a remittance.

BUSINESS OPPORTUNITIES

WANTED—To buy patents for articles that will have large sale and can be retailed at from 10 cents to $5.00 each. For further particulars address Sales, Box 773, New York.

MARKETING INVENTIONS

IN CONNECTION with developments of its own laboratories the undersigned will consider any meritorious inventions ready for the market, especially those relating to motor car and mechanical lines. Address with copy of patent. McCormick Laboratories, McCormick Manufacturing Co., Dayton, Ohio.

WANTED

WANTED: Address of parties who can supply Cellulose Acetate in the form of shavings or chips. Address for further particulars "Cellulose" Box 773, New York.

INQUIRIES

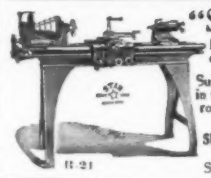
Inquiry No. 9416. Wanted an agency on the Pacific Coast for some specialties. Particularly inventions of merit.

Inquiry No. 9417. Wanted the name and address of a manufacturer of a machine for tying up fishing line and for carding the same

Inquiry No. 9418. Wanted the name and address of a manufacturer of fiber silk made of wood, a fiber suitable for undervests, etc.

ADVERTISING CLASSIFIED

LATHES AND SMALL TOOLS



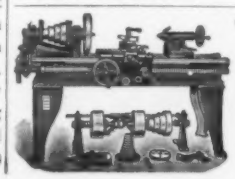
"STAR" Large Line of Attachments
For Foot or Power LATHES
Suitable for fine accurate work in the repair shop, garage, tool room and machine shop.
Send for Catalogue B
SENECA FALLS MFG. CO.
695 Water Street
Seneca Falls, N. Y., U.S.A.

The "BARNES" Positive Feed

Upright Drills
10 to 50-inch Swing
Send for Drill Catalogue
W. F. & Jno. Barnes Co.
Established 1872
1999 Ruby Street Rockford, Illinois

"RED DEVIL" NO. 900
HANDY COMBINATION TOOL
In a convenient 7-in. size, with hammer, side-cutting plier, screw driver, reamer, etc. Your dealer can supply, or send $1.25 for one sample only and booklet of "3000 RED DEVILS."
Send for Booklet anyhow.
SMITH & HEMENWAY CO., Inc., 155 Chambers St., New York

Strong Patent Diamond Holder
The up-to-the-minute Holder—with six points and a "shock absorber." Worth knowing about. Send for circular.
MONTGOMERY & CO., Tool Mongers
105-107 Fulton Street New York City



OUR BIGGEST LATHE VALUE.
16-inch Lathe with 6-foot bed, $252.00; other sizes at proportionately low prices. Every lathe guaranteed. Buy your lathe from us and save $50.00 or more. Machinery Catalog No. 70S13B sent free on request.
SEARS, ROEBUCK AND CO., Chicago.

sharp inversion of the record, fail, even though the plant is cooled down to its normal temperature. This death temperature of 60 degrees is constant for all plants.

Nerves or Mechanism—Which?

Is there a true excitatory change in the plant? If so, is there any specific contracting tissue, corresponding with the nerve of the animal, for the transmission of excitation? It is known that the excitation of a living animal tissue is attended by a concomitant electrical change of galvanometric negativity. If we make suitable galvanometric connections with two points on a nerve and we stimulate the nerve at a distant point, we shall find that the arrival of excitation from the distant stimulated point is at a proper moment signalized in the galvanometer by a deflection of a definite sign. Prof. Bose has found that the excitatory change of galvanometric negativity is similarly transmitted to a distance through certain plant-organs, thus proving that plants have nerves. By applying stimuli of constant intensity and by allowing proper intervals of rest, Prof. Bose has obtained successive values of the velocity of transmission, which values are constant. The highest velocity of transmission of excitation was found to be 30 millimeters a second in the petiole of Mimosa. The velocity varies with the tonic condition of the plant. Fatigue depresses the rate; high temperature increases it. Excitation is transmitted in both directions; but the velocity is not necessarily the same in the two cases.

Until Dr. Bose made his experiments it was the accepted theory that in plants like Mimosa there is merely a transmission of hydro-mechanical disturbance and no transmission of true excitation comparable with that of animal nerve. Haberlandt compared the excitatory movement of a Mimosa leaf with the effect produced when an India rubber tube containing water at a given hydrostatic pressure is pinched, with the result that the increase of pressure at any point is transmitted in the form of an undulatory wave. If this is so, transmission should always take place regardless of the physiological conditions. Haberlandt's theory and others like it must be abandoned. Prof. Bose found that excitatory reaction is indicated in the petiole of various plants by the discriminative polar action of an electric current; excitation is induced at the kathodic point at "make" and at the anodic point at "break." This transmission occurs in the absence of all mechanical disturbances. The excitatory nature of the impulse is further demonstrated by the arrest of conduction brought about by various physiological blocks. Moreover, local application of increasing cold retards and finally abolishes conductive power. Conductivity is even paralyzed for a time as an after-effect of cold, but the conducting power is quickly restored by tetanizing electric shocks. Conductivity of a selected portion of the petiole may be abolished by local application of poison, such as potassium cyanide. It is quite evident from all this that a plant, like an animal, has nerves.

Plant Tissues That Beat Like Hearts.

In certain plants we observe what are known as spontaneous movements. *Desmodium gyrans* or the telegraph plant of India is a conspicuous example. The lateral leaflets execute pulsating movements which are not unlike the rhythmic movement of the heart. Prof. Bose has studied this curious phenomenon and finds that it has more than a superficial resemblance to the beating of cardiac tissue.

Because a whole plant cannot be easily manipulated, Prof. Bose experiments with the detached petiole. A similar practice is followed by biologists in studying the action of the animal heart. As in the case of the isolated heart, the movement of the detached leaflet can be renewed by the application of internal hydrostatic pressure. The detached petiole is mounted in the apparatus shown in Fig. 14. In some experiments a modification of the resonant recorder must be employed—an instrument which Prof. Bose calls his oscillating recorder, in which the recording plate, by means of an electric motor provided with an eccentric is made to execute a to-and-fro movement. Thus, it becomes possible to use a light grass haulm for the recorder. When the resonant recorder is used the record appears dotted; with the oscillating recorder a dotted record is obtained. Fig. 10 shows how very regular are the pulsations obtained with detached petioles; this is a continuous record lasting four hours, the movements themselves being maintained uniform for more than seven hours.

The records obtained show that the rhythmic tissues of the plant are extraordinarily similar to those of the animal. By the application of ligature the pulsation of the heart is arrested; a similar arrest occurs in the telegraph plant by the proper application of ligature. Cold lowers the frequency of a frog's heart beat; it also lowers the frequency of the telegraph plant's pulsation. Rise of temperature produces an opposite effect in both the animal heart and in the beating leaflet. Alcohol and dilute carbon dioxide prolong the period, while strong applications arrest pulsation altogether. Dilute vapor of ether and carbon disulphide induce a temporary arrest, revival taking place after substitution of fresh air. Copper sulphate and potassium cyanide, both poisons, stop pulsation, potassium cyanide the more quickly of the two.

No satisfactory theory has been offered to explain these "spontaneous" movements. Prof. Bose believes that he has shown that there is no such thing as a spontaneous movement. The energy that makes a heart beat or a leaflet vibrate is derived from external sources directly or from the excess of such energy already accumulated and held latent in the tissue. When the stored supply is exhausted activity ceases, only to be renewed again by fresh stimulation.

With his remarkable instruments Prof. Bose has thus subjected plants to questioning shocks and recorded their answers. His records are in reality autographs which lay bare processes which have been wrapped in the profoundest mystery. The effects of environment, of stimulation, of variations in physiological activity are written down in a script that is as intelligible as the printed word on this page. The plant proves to be more closely allied to the animal than we suspected. Indeed, there is hardly any phenomenon of irritability observed in the animal which is not also found in the plant. Prof. Bose has therefore made not only a notable contribution to plant physiology, but he has widened our whole conception of organic life and has proved that there is but one life, whether it be the protoplasmic scum of a murky pool or man himself.

The Death of Lieut. Munby

WE regret to note that Lieut. Ernest John Munby of the British Royal Engineers has been killed in action. Mr. Munby was born at Turvey Beds, Bedfordshire, England, May 19th, 1875. He attended the famous Rugby public school, and in 1893 came to the United States and entered the Stevens Preparatory School at Hoboken, and later attended the Stevens Institute of Technology, from which he graduated in 1897 with honors. Mr. Munby was a mining engineer and practised his profession in various parts of the country. He was also an engineer on the Steinway tunnel. In 1907 he became an associate editor of the SCIENTIFIC AMERICAN and continued in this capacity until his professional labors called him to Colorado. Mr. Munby went to England last summer, intending to return to Colorado in the autumn. At the outbreak of the war Mr. Munby was extremely anxious to volunteer. There were some difficulties at first, as at that time they were accepting only comparatively young men; finally, however, his professional attainments won the day, and he was commissioned as a lieutenant in the Royal Engineers. Since the outbreak of hostilities we received several interesting letters from Mr. Munby, which showed his rare ability as a correspondent. All Mr. Munby's friends will be sorry to learn of his heroic death.

How a Spring Works

The trouble with a spring is that it springs back. There's nothing neutral about a spring under compression. Its tendency is to go back to its normal position altogether too quickly for comfort.

There's enough power in a good spring, if it were used as a bow, to shoot you over a tree like an arrow. When four such springs rebound on a country road you suffer the sensation in a modified degree of being catapulted into the air.

The New Automatic Hartford Shock Absorber soothes the angry spring. When the spring is subjected to more than normal compression, the Hartford takes hold and eases it firmly but gently back to normal. No jar—no recoil—no stiffness—just an equalizing of spring action into long, undulating waves of motion.

*Hartford
SHOCK ABSORBER
Soothes the Angry Spring

The Hartford works progressively—automatically. When spring action is slight its touch is gentle but its control is firmer and firmer as spring action increases. This is accomplished by a series of internal discs, engaging progressively.

Hartford Shock Absorbers add immensely to the comfort of riding; they keep the wheels on the ground and thus prevent accidents; and they add to the life of machinery and tires.

Let us send you a book which will tell you why the Hartford Shock Absorber is standard equipment on so many prominent cars and why 85% of the racing drivers use it. The book is free.

Automobile Manufacturers are now using the finest springs that can be made. If you want more comfort, you must use Hartford Shock Absorbers.

Hartford Suspension Co. E. V. HARTFORD, President
175 Morgan St., Jersey City, N. J.

BRANCHES:
New York, Boston, Philadelphia, Kansas City, Newark, Chicago, Pittsburgh, Indianapolis

*Formerly Truffault-Hartford

Makes Every Road a Boulevard

ADVERTISING CLASSIFIED

SPECIAL MACHINERY

MODELS for the CHICAGO MODEL WORKS
ESTABLISHED 1901

MANUFACTURING
WE HAVE FACILITIES FOR THE MANUFACTURE OF
Specialties in Both Metal and Wood
and would be glad to quote prices for experimental work or regular manufacturing. Address: Specialties, Box 773, N. Y.

THE SCHWERDTLE STAMP CO.
STEEL STAMPS LETTERS & FIGURES
BRIDGEPORT CONN.

RUBBER Expert Manufacturers Fine Jobbing Work
PARKER, STEARNS & CO.,
286-300 Sheffield Ave., Brooklyn, N. Y.

MODELS EXPERIMENTAL WORK
Equipment for Wood and Metal M'f'g—Draughting—Patterns
American Pattern, Foundry & Machine Co.
82-84 Church Street, New York

The Sanitary Toothbrush Holder
Patent For Sale.
Recommended by Bacteriologists in this country and England. Would like to correspond with manufacturers in the novelty line. See description, page 247, this issue. Dr. ERNEST C. DYE, Greenville, S.C.

EXTRAORDINARY OFFER—30 days free trial on this finest of bicycles—the "Ranger." We will ship it to you on approval, *freight prepaid*, without a cent deposit in advance. This offer is *absolutely genuine.*

WRITE TODAY for our big catalog showing our full line of bicycles for men and women, boys and girls at *prices never before equaled* for like quality. It is a cyclopedia of bicycles, sundries and useful bicycle information. It's free.

TIRES, COASTER-BRAKE rear wheels, inner tubes, lamps, cyclometers, equipment and parts for all bicycles at **half usual prices.** A limited number of second hand bicycles taken in trade will be closed out at once, at $3 to $8 each.

RIDER AGENTS wanted in each town to ride and exhibit a sample 1915 model **Ranger** furnished by us.

It Costs You Nothing to learn what we offer you and how we can do it. You will be astonished and convinced. **Do not buy a bicycle,** tires or sundries until you get our catalog and new special offers. **Write today.**

MEAD CYCLE CO., Dept. M-175, CHICAGO, ILL.

YOU CAN DRILL WHERE YOU CANT DIG

There is a big opportunity in every community for a capable man to establish himself in the well drilling business and make money. The right kind of a man with the right kind of equipment can be independent. Let your equipment be

THE STAR DRILLING MACHINES

Equipped with either steam or gasoline power. Thousands of STARS are now in use. The demand for drilled wells is increasing. You can drill where you can't dig. It is a well known fact that there are but few places where water cannot be obtained by drilling. Write us today for catalogs (enclose 6c for postage) and let us show you the superiority of STARS. Furnished on payments, if desired.

THE STAR DRILLING MACHINE CO.
508 Washington Street Akron, Ohio

Sober Paragon Chestnut Trees

One crop brought $30,000. Plant for profit, for pleasure or for decoration—plant a thousand trees or a single one. A **sale tree** to plant in **zero climates,** or in **hot climates.** Succeeds in drought, in frost, and in poor soil and upon steep hillsides—the roughest of lands. ***Every tree we ship this spring bore chestnuts last season.*** We secured exclusive control of this variety in 1908, when we introduced it, and sold the first trees. Every year our stock has improved and we now have 100,000 **bearing** trees to offer. **CAUTION—Be sure your trees bear our metal, copyrighted seal** with the trade mark name "Sober Paragon."

Our 1915 Catalog and Planting Guide—Includes Nut Culture, Fruits, Roses, Shrubs, Evergreens, etc., mailed FREE.

GLEN BROS., Inc., Glenwood Nursery, 1745 Main St., Rochester, N. Y.

Alexander H. Revoll

Walter H. Cottingham

Hugh Chalmers

Theodore P. Shonts

Joseph Vehon

What's Coming in Business?

Successful men say they will read March SYSTEM to find out

Isadore Saks, President of Saks & Company: "I have gone over the articles you enclosed and find them very interesting. As a subscriber to SYSTEM no doubt I shall have the pleasure of reading these articles from time to time."

Edward D. Easton, President of the Columbia Graphophone Company: "I have read SYSTEM for many years and believe it is safe to say I have never picked up a single copy without finding something of real value and help in my affairs."

Theodore P. Shonts, President of the Interborough Rapid Transit Company: "It is the task of SYSTEM to search out and record the progress of the evolution of business. Such work is worth doing and I find it worth my time to follow SYSTEM in it."

Hugh Chalmers, President Chalmers Motor Company: "SYSTEM is one of the few magazines I take home to read. I find helpful ideas in it. I think one of the reasons SYSTEM is unusually successful is because its articles are practical and easily adaptable to everyday business conditions."

Jno. R. Simpson, Vice-President of Wm. Filene's Sons Company: "I think it will be very helpful to business men generally to read in March SYSTEM a resumé of the opinions of leading men on 'What's Coming In Business?' I shall read it."

Walter H. Cottingham, President of the Sherwin-Williams Company: "I have been a subscriber to SYSTEM since it was first published and have received many good ideas. Any business man can use SYSTEM to good advantage."

Alexander H. Revoll, President of Alexander H. Revoll & Company: "The opinion of prominent men of industry on 'What's Coming In Business?' in March SYSTEM, will be of unusual value to business men, and as a regular reader of the magazine it will have some of my time."

Joseph Vehon, President of The Royal Tailors: "Judging from advance proofs of 'What's Coming In Business?' to appear in March SYSTEM, I shall call this issue to the particular attention of every executive in our organization."

A. C. Brown, President of the Hamilton-Brown Shoe Company: "My father was a business man of the old school and probably would not have given a snap of his finger for a magazine on business, but we of the younger generation realize that many a helpful hint comes from other concerns through just such an organization as yours. We find SYSTEM well worth reading."

Isadore Saks

Jno. R. Simpson

Edward D. Easton

A. C. Brown

SYSTEM
THE MAGAZINE OF BUSINESS
EDITED BY A.W. SHAW
World conditions are narrowing the margin of profit •• Rising costs are forcing vital, drastic readjustments in business ••• In this issue builders of American business forecast for you
WHAT'S COMING IN BUSINESS
PRICE 20 CENTS
MARCH·1915
$2.00 A YEAR

These men are planning for the future with the experience of thousands to guide them

Remarkable as has been the past success of the merchandising genius of America, *he* does not rely on this alone to fight the business battles of tomorrow.

And the man who has worked up to the top of a $35,000,000 concern—and the man who built a nation-wide industry in two short years, these men, too, will turn to March SYSTEM for new ideas, inspiration, answers to problems, tested experience.

So will E. W. Darrell, the enterprising Newton Grocer—and so will *471,000 other business executives*—large and small, in all lines—use March SYSTEM (just as they do *every* issue) to save their time and multiply their dollars. Can you look into the faces of these men and say: "They are mistaken—I will not trust their judgment—I am better prepared than *they* to seize new opportunities and make my business grow?"

Examine the Big March SYSTEM

After the President of the Remington Typewriter Company had examined his first copy of SYSTEM, he said: "I was *surprised* to find prominent business men giving up secrets and experiences worth great sums of money." You, too, if you have not seen SYSTEM lately, will be surprised at the practical and timely help you will secure from this March issue alone.

"What's Coming in Business" is but one of the 21 startling articles, 76 specific plans, 67 short cuts for getting more business and reducing expenses. The answer to the very problem that baffles you *today*—already solved by some other business man—may be in March SYSTEM—yours at the turn of the page and glance of the eye.

Will you deny your business and yourself the advantage so many other men possess, when to *investigate* March SYSTEM means simply to send the attached coupon at *our* risk?

Wabash Ave. and Madison St., Chicago — **A. W. Shaw Company** — 461 Fourth Ave. New York

No-Risk Offer

A. W. Shaw Company
Wabash Ave. and Madison St., Chicago

I want to find out what's in SYSTEM—for *me*—so send me the big March Annual. I enclose $2 which will be returned to me at the end of a week if I am not *more* than pleased; otherwise SYSTEM is to come to my office regularly for a full year. Z-3-13

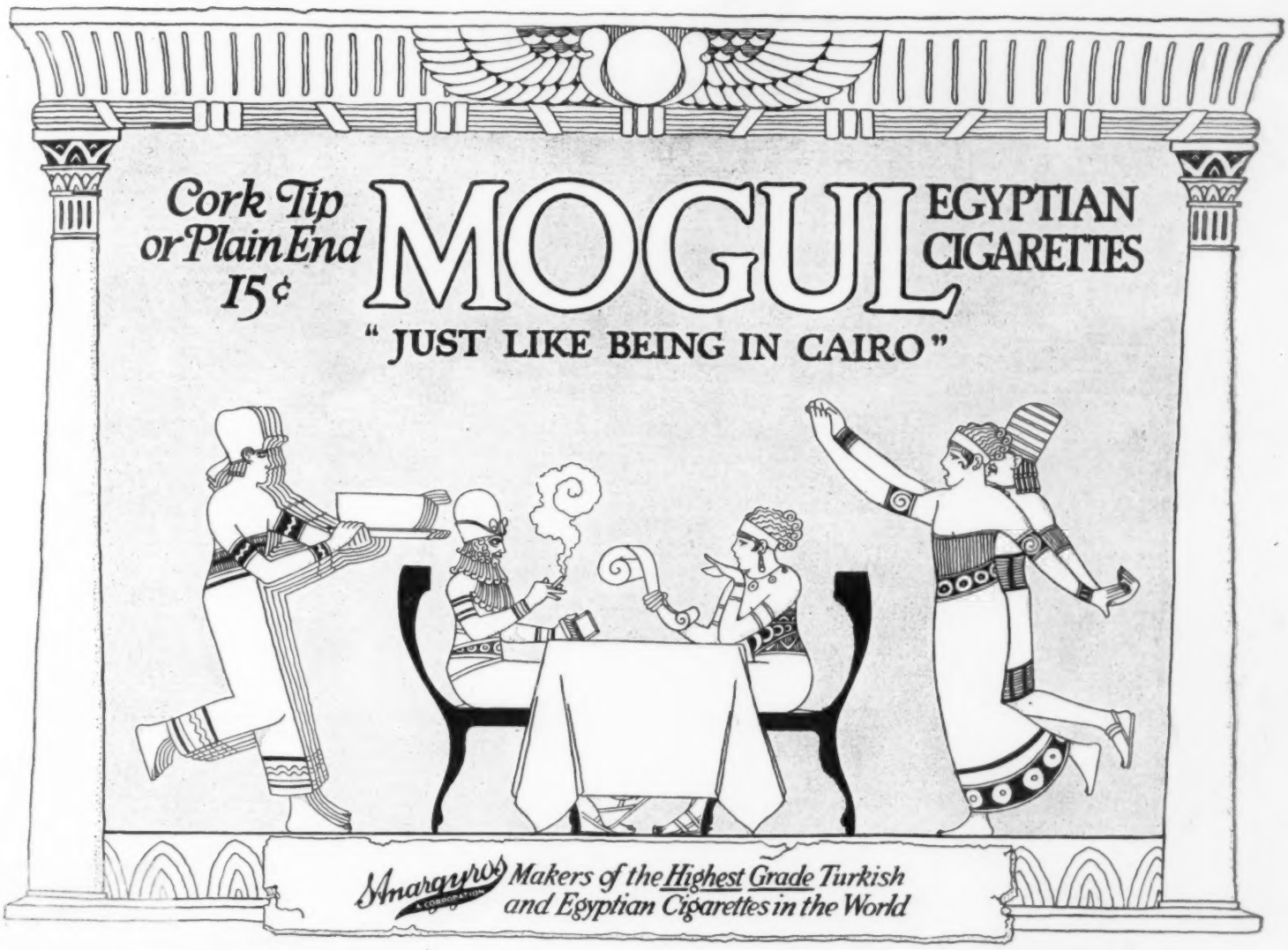
Name _____

Address _____

_____

Firm _____

Position _____



VALUABLE BOOKS
of Instruction and Reference

Scientific American Cyclopedia of Formulas

Edited by ALBERT A. HOPKINS. 6½x8¼. 1077 pages. 200 illustrations. Cloth, $5.00. Half morocco, $6.50.

¶ The most complete book of receipts published, containing about 15,000 selected formulas, covering nearly every branch of the useful arts and industries. Never before has such a large collection of formulas, useful to everyone, been offered to the public. Almost every inquiry that can be thought of relating to formulas used in the various manufacturing industries will be found answered in this volume. Those in search of salable articles that can be manufactured profitably on a small scale, will find hundreds of excellent suggestions.

Concrete Pottery and Garden Furniture

By RALPH C. DAVISON. 5¼x7½. Cloth. 196 pages. 140 illustrations. Price, $1.50.

¶ This book describes in detail, in the most practical manner, the various methods of casting concrete for ornamental and useful purposes. It tells how to make all kinds of concrete vases, ornamental flower pots, concrete pedestals, concrete benches, concrete fences and many other objects of cement for the adornment of the home or garden. A valuable chapter on color work is included.

Scientific American Reference Book

Edition of 1914. Compiled and edited by ALBERT A. HOPKINS and A. RUSSELL BOND. 5¾x7½. Cloth. 597 pages, 1000 illustrations. Price, $1.50.

¶ A handy, compact, reliable and up-to-date volume for every-day reference, containing a remarkable aggregation of facts, statistics and readable information along industrial, commercial, scientific and mechanical lines of general interest. It is a revelation of facts and figures, and will prove invaluable on the desk of the business man, as well as the library of the home.

Experimental Science

Elementary Practical and Experimental Physics. By GEORGE M. HOPKINS. 2 volumes. 6¼x9¼. Cloth. 1100 pages, 900 illustrations. Price, $5.00.

¶ This work treats on the various topics of physics in a popular and practical way and contains a fund of trustworthy scientific information presented in a clear and simple style. The aim of the writer has been to render physical experimentation so simple and attractive as to induce both old and young to engage in it for pleasure and profit. In the latest edition the scope of the work has been broadened, presenting the more recent developments in modern science.

Handy Man's Workshop and Laboratory

Compiled and edited by A. RUSSELL BOND. 6x8¼. Cloth. 467 pages, 370 illustrations. Price, $2.00.

¶ A compilation of hundreds of valuable suggestions and ingenious ideas for the mechanic and those mechanically inclined. The suggestions are practical and the solutions to which they refer are of frequent occurrence. It may be regarded as the best collection of ideas of resourceful men published, and appeals to all those who find use for tools either in the home or workshop.

Monoplanes and Biplanes

Their Design, Construction and Operation. By GROVER CLEVELAND LOENING, B.Sc., A.M., C.E. 6¼x8¼. Cloth. 331 pages, 278 illustrations. Price, $2.50.

¶ This work covers the whole subject of the aeroplane, its design and the theory on which the design is based, and contains a detailed description and discussion of thirty-eight of the more highly successful types. It is a thoroughly practical work, and invaluable to anyone interested in aviation.

WE SEND THESE BOOKS BY MAIL OR EXPRESS PREPAID UPON RECEIPT OF THE ADVERTISED PRICES. OUR CATALOGUE OF SCIENTIFIC AND TECHNICAL BOOKS SENT FREE ON REQUEST. SEND US YOUR ORDER OR REQUEST TODAY

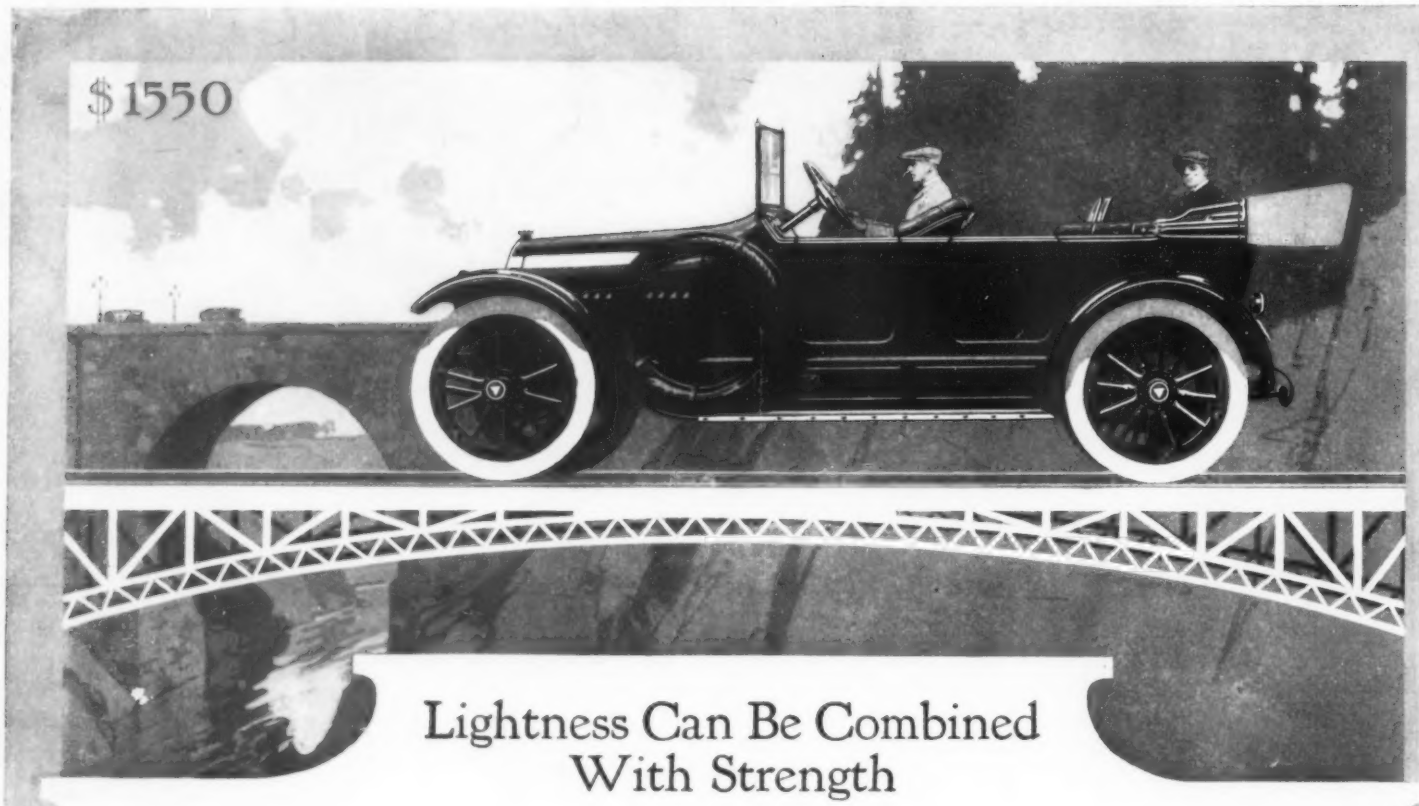
MUNN & CO., Inc., *Publishers* **361 Broadway, New York, N. Y.**

The Kaiser and Senator Beveridge talked together for two hours and in the March 27th issue of Collier's Senator Beveridge describes his visit.

The Kaiser had not then, nor has he yet, received any foreigner since the war began with the exception of Collier's exclusive correspondent, Senator Beveridge.

Field Marshal von Hindenburg and Admiral von Tirpitz were also visited by Senator Beveridge, and in "A Visit to the Kaiser and Two of His Fighting Chiefs" he presents these three great German leaders to the readers of

5¢ a copy
Collier's
THE NATIONAL WEEKLY



Lightness Can Be Combined With Strength

HUDSON PROVED IT

When light steel bridges took the place of stone, there came up the question of strength in them.

When steel buildings displaced solid masonry, the question arose again.

So in automobiles. The early high-grade Sixes weighed 4500 pounds. That overtax in tires and fuel barred the Six to most men. Now it is known that overweight was a crudeness, a weakness in itself.

The Hudson Remedy

Howard E. Coffin, the great HUDSON engineer, long ago decided that lightness could be combined with strength. He displaced cast iron with aluminum. He adopted pressed steel. He re-designed a thousand parts to secure staunchness without weight. His hollow driving shaft illustrates one method of weight reduction.

Then he designed a small-bore, high-speed motor. That let him lighten a hundred parts because of the lesser shocks.

After four years of effort, the final result is this HUDSON for $1550. It weighs 2890 pounds, ready for the road. As compared with old-time Sixes, it has cut fuel and tire cost in two.

Excess Out-of-Date

The Light Six vogue started with this HUDSON. Now crude excess is distinctly out-of-date. The leading cars average hundreds of pounds less than last year. But the HUDSON, because of our years of refinements, is the lightest in its class—the lightest 7-passenger Six.

This year, if you pay between $1000 and $2000, you are pretty sure to want a Light Six. Your sole question is, "Which is the best Light Six"?

10,000 Men Say Hudson

Over 10,000 men chose the HUDSON. Half of them bought last year's model, and have driven it two seasons. Half bought this year's model. Together they have driven this car, perhaps 25 million miles.

They have proved it right. They have found no weakness, no shortcoming. Any owner around you will say that.

That's the all-important point. Every old-time standard has been radically revised in creating the Light Six. And only time and tests can demonstrate the avoidance of mistakes.

The HUDSON has met those tests. It is a proved success. Its buyers take no chances. It is, in addition, a Howard E. Coffin model. It is a finished product, showing the results of four years of refinement. We believe that you'll select it.

HUDSON Six-40 Seven-Passenger Phaeton, $1550, f. o. b. Detroit. Four other styles of bodies.

The HUDSON Company never loses interest in the cars it sells. So long as a car is in service we maintain our interest in the character of its service. That's one great reason for HUDSON reputation.

HUDSON MOTOR CAR COMPANY
Detroit, Michigan